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SUSTAINABILITY AND ECONOMIC RESILIENCE

in the context of global systemic transformations

5th EDITION

CHIȘINĂU, 2026

Academy of Economic Studies of Moldova

Department of Economic Theory and Policy

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**SUSTAINABILITY AND ECONOMIC
RESILIENCE IN THE CONTEXT OF GLOBAL
SYSTEMIC TRANSFORMATIONS**

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DIGITAL TRANSFORMATION AND ECONOMIC RESILIENCE: HOW DIGITAL ECOSYSTEMS STRENGTHEN ADAPTIVE CAPACITY IN EMERGING ECONOMIES

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Abstract: *The claim that digitalisation strengthens the resilience of emerging economies is widely asserted but rarely tested with the precision the concept demands. This paper distinguishes resilience into a resistance margin (the depth of contraction under a shock) and a recovery margin (the speed, reach, and inclusiveness of the rebound and of relief delivery), and asks which margin national digital ecosystems actually strengthen. Using a comparative policy analysis of six economies (Brazil, India, and Kenya as a global frontier, Estonia as a regional frontier, and Ukraine and Moldova as diagnostic cases) across two sequential shocks (the COVID-19 pandemic and the 2022 energy-and-war disturbance), it triangulates cross-country indicators, within-case process tracing, and existing empirical evidence. Digital maturity does not explain contraction depth: five of the six economies sit in the top GovTech maturity group, yet their 2020 contractions varied widely and tracked lockdown stringency, economic structure, and exposure to energy and conflict rather than any digital indicator. Digital ecosystems instead governed the recovery margin, determining how quickly and how inclusively states reached and paid citizens through interoperable public rails. Moldova has shown it can wire infrastructure into crisis delivery: its 2022 “Ajutor la contor” energy-compensation system auto-targeted around three-quarters of households and cut energy poverty by 43%. But it did so reactively and for a single sector; the task is to institutionalise permanent, pre-positioned, general-purpose rails.*

Keywords: *digital public infrastructure; economic resilience; adaptive capacity; emerging economies; shock-responsive social protection; GovTech; Moldova*

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1. Introduction

Between early 2020 and the end of 2022, many emerging economies absorbed not one large shock but two in quick succession. The COVID-19 pandemic produced the deepest synchronized global contraction since the Second World War, and before recovery was complete, the full-scale invasion of Ukraine in February 2022 triggered an energy-and-food price spike and a wave of inflation that fell hardest on small, import-dependent states. For a country such as Moldova, the two shocks arrived almost back to back: output fell by roughly 8% in 2020 and again by about 5% in 2022, the second decline compounded by an energy crisis, a refugee influx, and a severe drought (World Bank, 2024). The practical question facing policymakers in such economies is no longer whether shocks will come, but what determines how quickly and how inclusively a country can respond when they do.

Over the same period, digital ecosystems moved from the margins of development policy to its centre. Governments across the emerging world accelerated investment in connectivity, digital identity, real-time payment systems, and online public services, and a growing body of commentary has treated this digital build-out as a source of economic resilience in its own right. The intuition is appealing: an economy that can identify, reach, and pay its citizens electronically should be better placed to cushion a downturn and to recover from it. During the pandemic this intuition appeared to be vindicated at scale, as states delivered emergency

cash to hundreds of millions of people through digital channels that had been built, in most cases, well before the crisis (Gentilini et al., 2022).

Yet the claim that digitalisation makes emerging economies more resilient is asserted far more often than it is tested, and it is rarely stated precisely enough to be testable. Resilience is not a single quantity. An economy can resist a shock shallowly, recover from it quickly, or transform its structure in response, and these are distinct margins that need not move together (Martin, 2012). A digital ecosystem that accelerates recovery is doing something quite different from one that limits the initial contraction, and conflating the two produces both overclaiming and disappointment. This paper therefore reframes the question. Rather than asking whether digitalisation makes economies more resilient, it asks *which margin of resilience* digital ecosystems actually strengthen, *through what mechanism*, and *what follows for policy* in an emerging economy that has invested in digital infrastructure but has not yet reaped a clear resilience dividend.

To answer these questions the study compares six economies that span three models of digital infrastructure and two very different shocks. Brazil, India, and Kenya serve as a global frontier that establishes the mechanism; Estonia serves as a regional frontier that shows the architecture is reachable by a small post-Soviet state; and Ukraine and Moldova serve as diagnostic cases read against that frontier, with Moldova as the focal case. The central finding is that digital maturity does not explain how deeply these economies contracted – the resistance margin tracked lockdown policy, economic structure, and exposure to energy and conflict, not any digital indicator. What digital ecosystems demonstrably governed was the recovery margin: how quickly, how widely, and how inclusively states could deliver relief, and the structural transformation that interoperable payment rails set in motion. The policy variable that carries this dividend is not connectivity or a broad portfolio of e-services but interoperable public rails wired into crisis delivery, a design choice as available to a small economy as to a large one.

The paper's contribution is to connect four literatures that rarely meet (economic resilience, digital public infrastructure, shock-responsive social protection, and GovTech maturity) and to use that synthesis to produce an actionable diagnosis. For Moldova, the conclusion is specific and encouraging: the country has already built the infrastructure layer that places it among the more digitally mature states in its region, and the remaining task is the narrower one of connecting that infrastructure to crisis-response functions. The argument proceeds as follows. Section 2 reviews the four literatures and locates the gap. Section 3 sets out the comparative methodology, the two-shock window, and the way resilience and adaptive capacity are operationalised. Section 4 presents the evidence and discussion across the six cases. Section 5 draws conclusions and policy implications, with particular attention to Moldova.

2. Literature Review

2.1 Economic resilience: from a single outcome to a multi-margin construct

The concept of economic resilience entered mainstream economics largely through the study of how regions and countries respond to recessions and disasters, and its most useful feature for the present argument is that it was never meant to be a single number. Martin (2012) distinguished several dimensions of resilience (resistance to a shock, the speed and extent of recovery, and longer-run reorientation) and argued that an economy can perform well on one

dimension and poorly on another. Martin and Sunley (2015) later cautioned that the term risks becoming a catch-all unless these dimensions are kept analytically separate. A parallel strand, rooted in disaster economics, made a similar move: Rose (2007) separated inherent from adaptive resilience and emphasised the capacity to maintain function during and after a shock rather than simply to avoid losses. Briguglio et al. (2009) added the policy-facing insight that vulnerability and resilience are distinct, so that an economy may be highly exposed to shocks yet build offsetting resilience through deliberate institutional choices.

Running through this literature is the absorptive–adaptive–transformative typology articulated most influentially by Béné et al. (2012), which this paper adopts. Absorptive capacity is the ability to cope without structural change; adaptive capacity is incremental adjustment; transformative capacity is systemic reconfiguration. Hallegatte (2014), writing for the World Bank, operationalised resilience in terms that map onto recovery: the macroeconomic cost of a shock depends heavily on the speed with which an economy can reallocate resources and restore activity. The collective implication is that any claim about what makes economies more resilient must specify *which margin* it is acting on. A theory that improves recovery is not the same as one that reduces the depth of the contraction.

2.2 Digital ecosystems and development: from “digital dividends” to public infrastructure

The literature linking digital technology to economic outcomes has shifted markedly in framing over the past decade. The World Bank’s World Development Report 2016 (World Bank, 2016) set the early tone with its “digital dividends” thesis, arguing that connectivity raises growth, jobs, and service delivery, but warning that the dividends fail to materialise without complementary “analogue” foundations such as regulation, skills, and accountable institutions. That qualification matters here: it implies that connectivity alone is a weak predictor of outcomes, which is precisely what the present evidence shows. More recent work narrows the focus from connectivity to architecture. Alonso et al. (2023), analysing India’s digital stack for the IMF, argue that the decisive ingredient is interoperable digital public infrastructure (a layered combination of digital identity, real-time payments, and consented data exchange) rather than digitisation in general. Studies of fast-payment systems make the same point empirically, documenting how state-sponsored, interoperable rails such as Brazil’s Pix reshaped payment behaviour at population scale within a few years of launch (Duarte et al., 2022).

A distinct and older empirical literature on mobile money supplies the strongest causal evidence that digital rails build household-level resilience. Jack and Suri (2014) showed that M-Pesa improved risk-sharing in Kenya, allowing households hit by shocks to smooth consumption by drawing on remittances that moved faster and more cheaply than before; Suri and Jack (2016) found durable poverty-reduction effects. This work is rarely cited in the macro-resilience literature, yet it identifies the micro-mechanism (faster, cheaper transfer of value under stress) that scales up to the national patterns observed during COVID-19.

2.3 The delivery channel: shock-responsive social protection and digital G2P

A third literature, largely separate from both of the above, studies how states deliver assistance during crises. Research on shock-responsive social protection (O’Brien et al., 2018) argues that the capacity to scale relief quickly depends on systems built *before* the shock (social registries, payment mechanisms, and identification) that can be expanded or repurposed when a crisis hits. The COVID-19 period produced an unusually rich evidence base: Gentilini et al. (2022) documented a worldwide surge in social-assistance measures, a

large share delivered through digital payments, and noted that countries with pre-existing digital delivery systems mounted faster and broader responses. This is the literature that names the capability this paper calls “adaptive wiring”: the integration that connects digital public infrastructure to crisis delivery. Its limitation is that it treats digital systems instrumentally, as plumbing for social protection, without locating them within a theory of economic resilience.

2.4 E-government and GovTech in transition economies

For the Eastern European cases, the relevant strand is the long-running study of e-government in developing and transition states. Heeks (2003) warned early that a large share of public-sector ICT projects fail because of “design–reality gaps” between imported systems and local institutional conditions. The caution applies directly to economies that have digitised services without integrating them. More recent benchmarking through the World Bank’s GovTech Maturity Index (World Bank, 2022) and the United Nations E-Government Survey provides comparative measures of how far states have built core systems, service delivery, and enablers. These instruments are descriptive rather than explanatory: they rank maturity but do not test whether maturity translates into resilience, and as the present study shows, high maturity scores coexist with very different shock outcomes.

2.5 The gap

These four literatures rarely speak to one another, and the silence is where this paper sits. The resilience literature offers a multi-margin framework but seldom specifies the digital mechanism that would move any particular margin. The digital-development and DPI literature identifies interoperable public rails as decisive but connects them to growth and inclusion rather than to a resilience framework with distinct resistance and recovery margins. The shock-responsive-social-protection literature names the delivery capability but treats it as administrative plumbing. And the GovTech literature measures maturity without testing its consequences. No existing work, to our knowledge, brings these together to ask which margin of resilience digital ecosystems actually strengthen, tests the question across economies facing both a common and a region-specific shock, and translates the answer into a policy diagnosis for a specific emerging economy. That is the contribution this paper makes, with Moldova as the focal case.

3. Methodology

3.1 Research design

This study is a comparative policy analysis built on a three-tier case architecture rather than a flat cross-country sample. The design separates the cases by the analytical role they play. A first tier of *global frontier* economies (Brazil, India, and Kenya) establishes the mechanism: it shows how a mature digital ecosystem converts into adaptive capacity when a large shock arrives. A second tier consists of a single *regional frontier* case, Estonia, which serves as the aspiration point and demonstrates that the frontier is reachable by a small post-Soviet economy. A third tier of *diagnostic* cases (Ukraine and Moldova) is then read against the first two, not to be ranked but to locate where each Eastern European economy sits relative to the frontier and which policy choices would close the distance. Moldova is the focal case; the others are calibrated around it.

The logic is benchmark-and-backdrop. Frontier cases supply the standard of what interoperable digital infrastructure can do under stress; the diagnostic cases are interpreted on that backdrop. This converts the study from description (“how digital is Moldova?”) into a policy argument (“the frontier shows that design choice X produces resilience outcome Y, which Moldova has not yet realised”). Methodologically it combines structured-focused comparison (George & Bennett, 2005) with descriptive cross-country indicator analysis. The two are complementary: indicators establish the broad association between digital maturity and macroeconomic outcomes, while the focused cases trace the mechanism through which a digital ecosystem actually transmits resilience, which correlation alone cannot reveal.

3.2 The shocks: a common disturbance and a sequential second test

The analysis uses the COVID-19 pandemic as the common shock across all cases. Its methodological value is that it arrived almost simultaneously in early 2020, was exogenous to any country’s digital policy, and produced both a sharp contraction (2020) and a measurable recovery (2021–2022). That timing approximates a natural experiment, allowing differently-equipped economies to be compared against the same disturbance.

The Eastern European cases carry a second, regionally specific shock that the global frontier did not face in the same form: the disturbance associated with Russia’s full-scale invasion of Ukraine in February 2022. For Ukraine this shock was direct and existential; for Moldova it arrived as spillover: an energy crisis, a refugee influx, and an inflation surge compounded by a severe drought. Treating the diagnostic cases as subject to two sequential shocks is deliberate. A digital ecosystem that demonstrably aids absorption of *both* a global health shock and a regional security-and-energy shock provides a far stronger test of adaptive capacity than a single episode. Estonia, by contrast, is used as a structural reference rather than a shock-tested case; the argument it carries is about architecture, not about its response to a particular disturbance.

3.3 Operationalising resilience and adaptive capacity

Economic resilience is operationalised, following Martin (2012), as a two-part construct rather than a single number. For economy i , resilience to a shock combines *resistance* (the depth of the output loss relative to the pre-shock trend) and *recovery* (the speed of return toward that trend):

$$R_i = f(\text{Resistance}_i, \text{Recovery}_i) \quad (1)$$

where Resistance is the gap between actual and counterfactual trend GDP at the trough, and Recovery is the time taken to regain the pre-shock output level. For the diagnostic cases the construct is observed across the two-shock window (2020 and 2022 troughs) rather than a single one. Defining resilience this way matters for the argument: a country can resist shallowly yet recover slowly, or contract deeply yet rebound fast, and digital ecosystems plausibly act on these two margins through different channels.

Adaptive capacity, the explanatory concept, is disaggregated into the three tiers established in the resilience literature (Béné et al., 2012): absorptive capacity (coping without structural change), adaptive capacity (incremental adjustment), and transformative capacity (systemic reconfiguration). Mapping digital-ecosystem functions onto these tiers is the analytical core of the paper: digital government-to-person payments serve absorption, e-commerce and digital service migration serve adaptation, and interoperable digital public infrastructure

(DPI) enables transformation. The comparison across cases is organised explicitly around how far up this ladder each economy's digital ecosystem carried it under shock.

3.4 Measuring the digital ecosystem

The digital ecosystem is decomposed into four layers, each measured with an established public indicator. Table 1 sets out the scheme.

Table 1. Analytical dimensions, indicators, and data sources

Ecosystem layer	Construct	Indicator	Source
Connectivity	Meaningful access	ICT Development Index (IDI)	ITU (2024)
Digital public infrastructure	ID, payments, data exchange	GovTech Maturity Index (GTMI)	World Bank (2022)
Market / platform	Digital commerce readiness	B2C E-commerce Index	UNCTAD (2021)
Skills & adoption	Firm and household uptake	Enterprise Surveys; Global Findex	World Bank (2021, 2022)

Source: compiled by the author.

Macroeconomic outcomes are drawn from the IMF World Economic Outlook database (real GDP growth and output paths, 2018–2024). Two caveats attach to the indicator data and are carried through the analysis. First, the ITU revived the IDI in 2023 under a methodology that is not comparable to editions published before 2017, so the index is used cross-sectionally rather than as a time series across the break. Second, the 2024 IDI edition reflects 2022 data because of reporting lags, which constrains how tightly connectivity can be aligned with the 2020 trough.

3.5 Case selection and analytical approach

Case selection is purposive and follows a maximum-variation logic across region, ecosystem maturity, and shock type, so that the argument does not rest on a single development model. The six cases span three continents and three institutional models of digital infrastructure: state-led interoperable DPI (India, Brazil), mobile-money-led inclusion (Kenya), and the post-Soviet digital-state pathway (Estonia, Ukraine, Moldova). One analytic thread is intentional: Ukraine's data-exchange layer, Trembita, is built on the X-Road architecture pioneered by Estonia, so the regional frontier and the diagnostic case are technologically linked, which lets the study trace how a frontier design choice travels to a neighbouring economy under the most extreme conditions.

Within each case the study uses process tracing on documentary evidence (central bank and regulator publications, World Bank, IMF, and UN country material, and transaction-volume statistics) to establish whether and how the digital ecosystem mediated the shock response, rather than inferring mechanism from outcomes. Analysis then proceeds by triangulation across three streams: the descriptive cross-country indicator patterns, the within-case process evidence, and the synthesis of existing empirical estimates from the literature reviewed in Section 2. A finding is treated as robust only where the streams converge; divergences are reported rather than smoothed over.

Three limitations follow directly from the design and bound the claims. First, this is associational policy analysis, not causal identification: economies with deeper digital

infrastructure also tend to have greater fiscal space and stronger institutions, and the study cannot fully separate these. Second, the diagnostic cases face confounds that complicate attribution: Moldova's 2020 and 2022 contractions were amplified by drought, and Ukraine's wartime outcomes reflect physical destruction that no digital system could offset. The digital ecosystem is therefore treated as one resilience factor among several, not the sole driver. Third, Estonia functions as a structural reference rather than a matched comparator, and conclusions drawn from it concern architecture rather than measured shock response.

4. Results and Discussion

The hypothesis under test is that digitalisation makes emerging economies more resilient to shocks. The evidence assembled here does not support that claim in the simple form in which it is usually stated. It supports a sharper, more defensible version: digital ecosystems strengthen one specific margin of resilience (the speed and reach of relief and recovery), while leaving another margin, the depth of the initial contraction, largely to factors that have little to do with digital maturity. The six cases are presented first as macroeconomic trajectories, then decomposed along the resistance and recovery margins, and finally read through the mechanism that links the two.

4.1 Two shocks, six trajectories

Figure 1 plots real GDP growth for the six economies across the period that contains both the common COVID-19 shock of 2020 and the regional energy-and-war shock of 2022. Two features stand out. First, every economy contracted in 2020, but by very different amounts, from a barely perceptible -0.3% in Kenya to -8.3% in Moldova (World Bank, 2024).

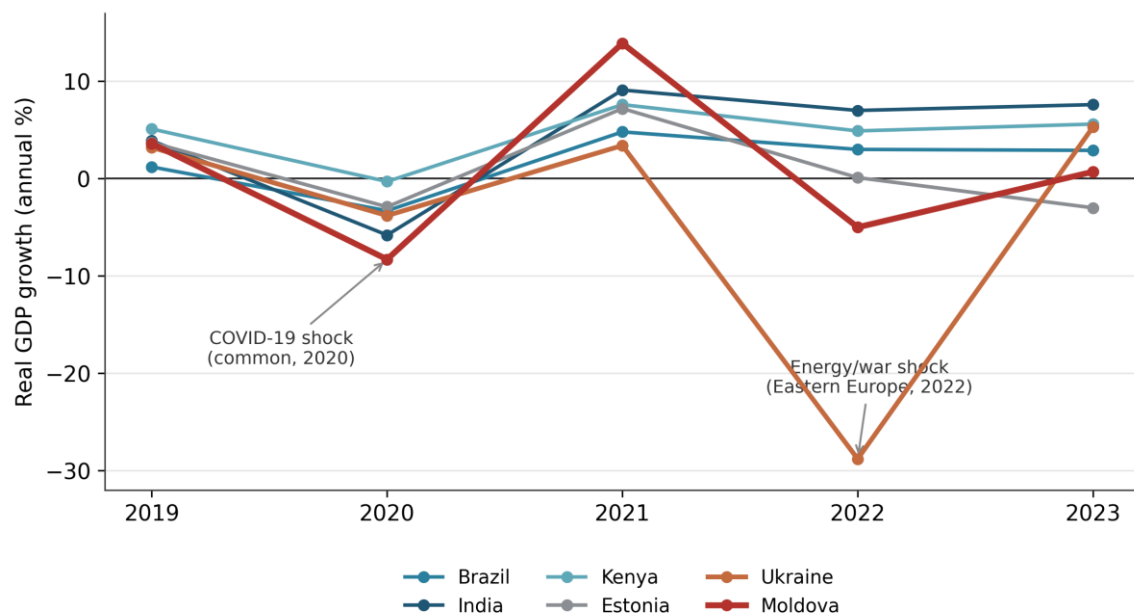


Figure 1. GDP growth paths across two shocks, 2019-2023

Source: World Bank / IMF World Economic Outlook. India on fiscal-year basis; Moldova 2020 on the World Bank constant-LCU series.

Second, the Eastern European cases face a second trough in 2022 that the frontier economies do not: Ukraine's output collapsed by roughly 28.8% under invasion, and Moldova contracted by about 5.0% as the energy crisis, a refugee influx, and a further drought converged (World Bank, 2024; United Nations, 2026). The trajectories already hint at the central result: the size of the contraction does not line up with how digitally advanced these economies are.

Table 2 makes the comparison explicit, setting each economy's resistance (2020 trough) and recovery (2021 rebound) against its GovTech maturity and the digital mechanism it actually used during the crisis.

Table 2. Resilience margins, digital maturity, and crisis-delivery mechanisms

Economy	Role	GTMI 2022 group	2020 resistance	2021 recovery	2022 second shock	Documented digital crisis response
Kenya	Frontier	B	-0.3%	+7.6%	+4.9%	CBK waived fees on M-Pesa transfers ≤ KES 1,000 (Mar 2020); +6.2 m active users by Oct 2022
Estonia	Regional frontier	A	-2.9%	+7.2%	+0.1%	X-Road interoperability; uninterrupted digital services
Brazil	Frontier	A	-3.3%	+4.8%	+3.0%	Auxílio Emergencial to ~68 m people via Caixa Tem; ~100 m newly banked in nine months
India	Frontier	A	-5.8%	+9.1%	+7.0%	PMGKY: ~340 m beneficiaries, ₹32,300 cr in weeks; AePS use doubled to ~11.3 m/day
Ukraine	Diagnostic	A	-3.8%	+3.4%	-28.8%	Diia/Trembita; 2.7 m aid applications in week 1; eDocument, IDP aid, eRecovery; ~19 m users
Moldova	Focal diagnostic	A	-8.3%†	+13.9%	-5.0%	“Ajutor la contor” (Oct 2022): digital energy-compensation system on compensatii.gov.md; Energy Vulnerability system auto-targeted ~895,000 households (~75%) using interoperable registry data; energy poverty cut 43%

Note: India on fiscal-year basis; †World Bank constant-LCU series (the World Bank country brief reports -7%).

Sources: World Bank (2022, 2024, 2025); ITU (2024); Government of India (2020); Central Bank of Kenya (2020, 2022); CGAP (2024); Government of the Republic of Moldova (2023); UNDP Moldova (2025).

4.2 What the data refute: maturity does not buy resistance

The first finding cuts against the naive hypothesis. Figure 2 arranges the six economies by GovTech maturity and shows, for each, the 2020 contraction alongside the 2021 rebound. Five of the six (Estonia, Brazil, India, Ukraine, and Moldova) sit in the top GovTech group (Group A) in the World Bank's 2022 index (World Bank, 2022). If digital maturity translated directly into the ability to withstand a shock, these five should have contracted least. They did not. Moldova, a Group A economy, suffered the deepest contraction in the sample (-8.3%); India, also Group A and home to the world's most-cited digital public infrastructure, contracted by -5.8%. Meanwhile Kenya, which sits a tier lower on GovTech, recorded the mildest contraction of all (-0.3%). The depth of the initial hit tracked the

stringency of lockdowns and the structure of each economy (the weight of agriculture and informality in Kenya, the severity of Moldova's simultaneous drought) far more than it tracked any digital indicator. On the resistance margin the hypothesis is not confirmed.

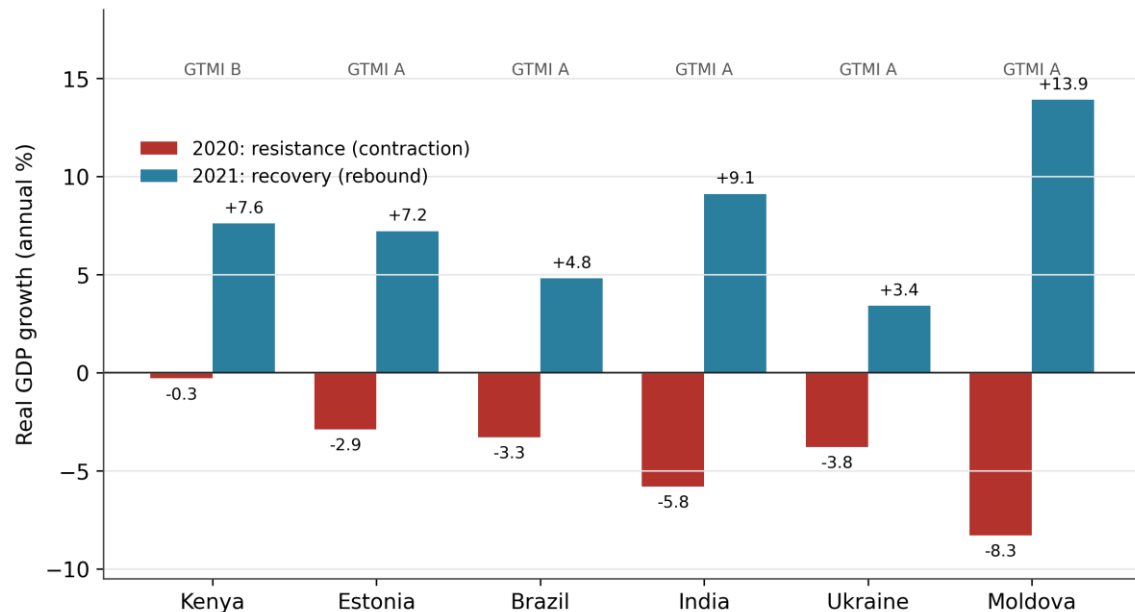


Figure 2. The COVID shock: contraction depth versus recovery, by GovTech maturity

Source: World Bank / IMF WEO; GovTech group from World Bank GTMI 2022. Five of six cases are GovTech Group A, yet 2020 contraction depth ranges from -0.3% to -8.3%.

4.3 What the data confirm: digital rails drive the reach and speed of response

The hypothesis recovers its force the moment attention shifts from the size of the contraction to the response. Here the evidence is strong and consistent across cases. Brazil's *Auxílio Emergencial* reached roughly 68 million people (over 40% of households) by routing payments through the *Cadastro Único* registry into *Caixa Tem* digital accounts, banking more than 100 million people in nine months (World Bank, 2021). India's *Pradhan Mantri Garib Kalyan* package put direct transfers into about 340 million Aadhaar-seeded accounts within weeks of the March 2020 lockdown, while daily use of the Aadhaar-enabled payment system doubled to roughly 11.3 million transactions (Government of India, 2020; Alonso et al., 2023). Kenya's central bank eliminated fees on small M-Pesa transfers from 16 March 2020 and watched 6.2 million additional citizens become active mobile-money users by October 2022 (Central Bank of Kenya, 2020, 2022). None of these states could prevent the shock; all of them could reach their populations through it, fast and at scale, because the rails were already laid.

That capacity is not only defensive. The same payment infrastructure that delivered relief also restructured these economies. India's Unified Payments Interface carried fewer than one billion transactions in FY2018 and more than 80 billion by FY2023; Brazil's Pix reached roughly 70% of the population within a few years of its 2020 launch (Duarte et al., 2022; ORF America, 2026). The digital ecosystem thus operates on the recovery margin on two fronts: it accelerates the rebound, and it changes the structure of the economy that rebounds. This is the confirmation the hypothesis deserves, and it is more specific than the original claim.

4.4 The extreme confirmation: Ukraine under war

Ukraine supplies the strongest single test. Diia, the government super-app launched in 2020, runs on the Trembita data-exchange layer built on the same X-Road architecture pioneered by Estonia (Ingram & Vora, 2024). When the full-scale invasion closed offices and displaced millions, the state delivered through this infrastructure: citizens filed over 2.7 million applications for war-related aid in the first week of March 2022 (CGAP, 2024), and new services (*eDocument* for those who fled without papers, internally-displaced-person payments, and *eRecovery* for war damage) were stacked onto the existing rails rather than built from scratch. With roughly 19 million users, Diia functioned as state-continuity infrastructure under the most extreme stress imaginable. No digital system could offset the –28.8% output collapse that physical destruction produced. But the ecosystem kept the state present and paying when its physical apparatus could not. This is the recovery-and-delivery margin operating at its limit.

4.5 The architectural lesson: Estonia and interoperability

Estonia clarifies why the frontier is reachable rather than reserved for large economies. With a population near 1.3 million it built X-Road so that registries and services communicate without a central database, and it made interoperability the organising principle of the digital state. The relevance is that the binding constraint on resilient digital ecosystems is architectural, not demographic: a small economy that invests in shared public rails can reach the frontier, while one that accumulates disconnected sectoral systems cannot, however many services it digitises. Estonia's own near-flat 2022 and contraction in 2023 also caution against overclaiming: a mature digital state is no shield against an energy-and-inflation shock transmitted through trade. The digital ecosystem shapes how a state responds, not whether the shock arrives.

4.6 The focal diagnosis: Moldova's reactive wiring

Moldova is where the comparison pays off, and the focal case requires more care than a first glance suggests. The country absorbed two large shocks in close succession (–8.3% in 2020 and –5.0% in 2022), and it is not a digital laggard; its e-Governance Agency had already built interoperable public rails and placed it in GovTech Group A (World Bank, 2022). When the 2022 energy crisis struck, Moldova did not improvise relief outside those rails. It built a genuinely digital shock-response system on top of them. The *Ajutor la contor* programme, launched in October 2022 and financed through the Energy Vulnerability Reduction Fund, delivered energy compensation through the *compensatii.gov.md* platform, where an “Energy Vulnerability” information system calculated each household's entitlement automatically and assigned it to one of seven vulnerability categories, drawing on data exchanged with the State Fiscal Service, the National Social Insurance House, and other state registries (Government of the Republic of Moldova, 2023; UNDP Moldova, 2025). The system reached roughly 895,000 households (about 75% of the country), and a UNDP impact evaluation found that it cut energy poverty by 43%, with the largest effect on the most vulnerable families. On the recovery-and-delivery margin, in other words, Moldova's digital ecosystem performed exactly as the frontier mechanism predicts: it let the state identify, target, and reach three-quarters of households at speed.

This finding strengthens the paper's thesis rather than complicating it, because *Ajutor la contor* is a Moldovan demonstration of the same recovery-margin capability that Brazil exercised through Caixa Tem and Ukraine through Diia. What distinguishes Moldova is not the absence

of adaptive wiring but its provisional form, and three features mark the distance from the frontier. First, the system was built reactively, during the shock, rather than pre-positioned before it; Brazil and India entered their crises with rails already in place, whereas Moldova assembled its delivery mechanism under duress in the autumn of 2022. Second, the system is sector-specific: an energy-compensation instrument rather than a general-purpose, reusable shock-response rail that the next, differently-shaped crisis could draw on. Third, its last mile depended heavily on human intermediation: more than half of beneficiary households registered with the assistance of registrars, and the programme leaned on social workers and librarians to enrol citizens who could not use the digital channel on their own, revealing a digital-divide constraint that the mobile-first frontier cases did not face in the same way.

Figure 3 locates this pattern. Moldova's ecosystem reached the adaptive tier and acted on the recovery margin through *Ajutor la contor*, but it did so as a single, improvised circuit rather than as permanent, general-purpose infrastructure. The diagnosis is therefore narrower and more encouraging than a maturity-deficit story would imply: Moldova has already proved, once and under pressure, that it can wire its digital public infrastructure into crisis delivery. The unfinished task is to institutionalise that capability: to convert a reactive, single-sector compensation system into a standing, multi-shock delivery rail that is ready before the next disturbance and reaches citizens with less dependence on assisted enrolment.

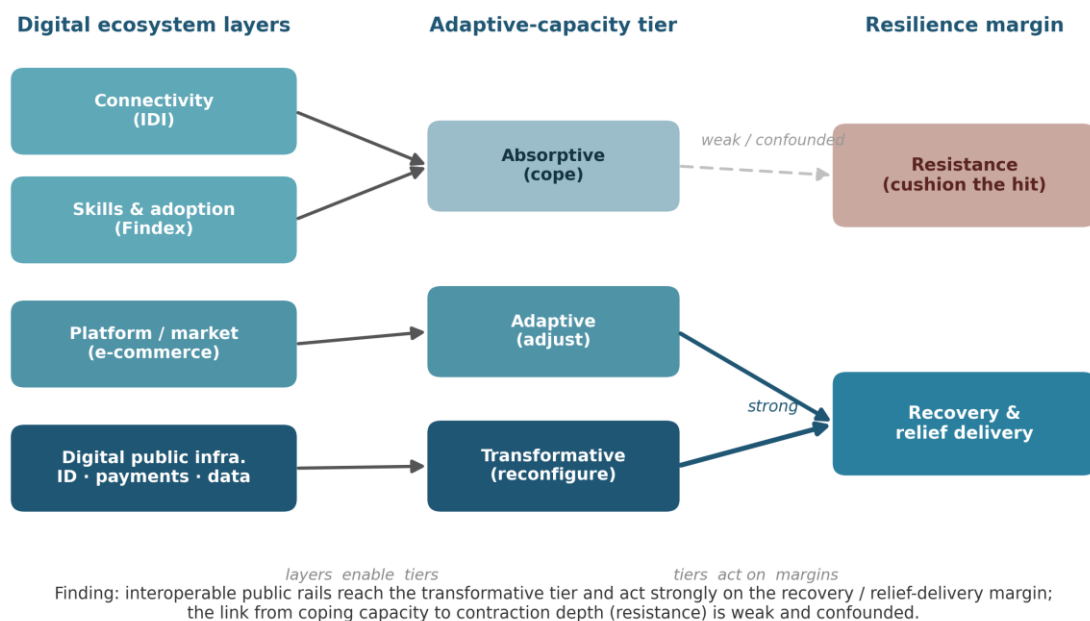


Figure 3. How digital ecosystems transmit resilience

Source: author's elaboration based on Béné et al. (2012)

4.7 Synthesis

Across the six cases the pattern is consistent. Digital maturity does not explain how deeply an emerging economy contracts when a shock lands; that resistance margin is governed by lockdown policy, economic structure, and, for Eastern Europe, by exposure to energy and conflict. What digital ecosystems demonstrably do is govern the recovery margin: the pace and the breadth with which a state can find and pay its population, and the structural transformation that interoperable payment rails set in motion. The hypothesis, then, is

confirmed in a revised and stronger form. The policy variable that carries the resilience dividend is not connectivity or a broad e-service portfolio but interoperable public rails wired into crisis delivery, and that is a design choice available to a small economy as much as to a continental one. Moldova has shown, through *Ajutor la contor*, that it can build the wiring even under pressure; the frontier shows the value of making that wiring permanent, general-purpose, and ready in advance.

5. Conclusions

This paper set out to test a claim that is asserted more often than it is examined: that digitalisation makes emerging economies more resilient to shocks. Examined across six economies and two very different disturbances, the claim does not survive in its general form, but it re-emerges in a sharper and more useful one. Digital maturity, measured by the indicators most commonly used to rank it, did not determine how deeply any of these economies contracted. The resistance margin, that is, the depth of the initial fall in output, tracked the stringency of lockdowns, the structure of each economy, and, for the Eastern European cases, exposure to energy and conflict. Five of the six economies studied sit in the top GovTech maturity group, yet their 2020 contractions ranged from negligible to among the deepest in the sample. On this margin, digital infrastructure is not the decisive variable, and policy framed as though it were will disappoint.

What digital ecosystems did govern, consistently and visibly, was the recovery margin. The capacity to identify, reach, and pay citizens through interoperable public rails determined how quickly and how inclusively states could respond once a shock had landed. Brazil reached more than two-fifths of its households within weeks through a registry-and-payment combination it had built in advance; India moved direct transfers into hundreds of millions of accounts through its identity-and-payments stack; Kenya kept money circulating by removing friction from a mobile-money network already woven into daily life; and Ukraine sustained the basic functions of the state under invasion through a digital ecosystem layered on Estonian-style interoperability. The same rails that delivered relief also restructured these economies, pulling activity into traceable digital channels and deepening financial inclusion. The resilience dividend of digitalisation is real, but it is earned on the recovery and delivery margin, not the resistance margin, and it is earned only where infrastructure has been wired into crisis-response functions before the crisis arrives.

For Moldova the diagnosis is specific and, on balance, encouraging. The country is not a digital laggard, and, contrary to what a maturity-deficit reading would suggest, it did not deliver its 2022 energy relief outside its digital infrastructure. Through *Ajutor la contor* it built a digital compensation system that auto-targeted some 895,000 households, about three-quarters of the country, and cut energy poverty by 43%. Moldova has therefore already demonstrated the recovery-margin capability that this paper identifies as the true resilience dividend of digitalisation. Its shortfall is not maturity, and no longer even the absence of wiring, but the provisional form that wiring took: reactive rather than pre-positioned, single-sector rather than general-purpose, and dependent on assisted enrolment at the last mile. The policy implications follow directly and are achievable rather than sweeping. First, generalise the Energy Vulnerability registry into a standing, multi-shock social registry, so that the next crisis, whatever its shape, can be met with a delivery system that already exists. Second, pre-authorise and maintain that system between shocks rather than rebuilding it under pressure each time. Third, invest in interoperable self-service access so that reaching vulnerable

households depends less on the extraordinary mobilisation of social workers than the 2022 season required. None of these steps asks Moldova to climb to a higher rung of digital maturity; each asks it to make permanent what it has already shown it can do.

These conclusions are bounded by the design that produced them. This is associational policy analysis across a small, purposive set of cases, not causal estimation: economies with deeper digital infrastructure also tend to have greater fiscal space and stronger institutions, and the analysis cannot fully separate these influences. The diagnostic cases carry confounds that no digital system could offset: Moldova's contractions were amplified by drought, and Ukraine's wartime collapse reflects physical destruction. The digital ecosystem is therefore best understood as one resilience factor among several rather than the decisive one. Estonia functions as a structural reference rather than a matched comparator. Future research could strengthen the argument in three directions: by constructing a panel that measures the integration between digital public infrastructure and social-protection delivery directly, rather than inferring it; by extending the comparison to a larger set of small open economies exposed to energy and trade shocks; and by evaluating, after the fact, whether reforms that wire infrastructure into crisis delivery measurably shorten recovery. For policymakers in Moldova and economies like it, the practical message is already clear enough to act on. The resilience payoff of the coming decade will come less from building more digital infrastructure than from connecting the infrastructure that already exists to the moments when citizens most need the state to find them.

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ECONOMIC SOLUTIONS TO GLOBAL FOOD WASTE

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Abstract: Food waste imposes significant financial challenges worldwide, nationally, and at individual levels, due to both the direct loss of income and indirect expenses from squandered resources and environmental consequences. The worldwide economic impact of food waste is estimated to be around \$1 trillion each year. The study was conducted by examining various reports and other publications of specialized international institutions and representatives of the expert community. The purpose of the research was to formulate possible economic solutions for the global reduction of food waste. Economic approaches to global food waste emphasize establishing financial incentives, promoting a circular economy. Economic perspectives on worldwide food waste involve shifting from a linear production model to a circular economy, aiming to enhance resource value and correct market inefficiencies. Important methods include repurposing waste into new items like biofuels or animal feed, enhancing cold storage facilities, and implementing policy measures to decrease food loss throughout the distribution network. Essential strategies comprise financial incentives for food donations, establishing markets for "imperfect" fruits and vegetables. Also of great importance is global food waste reducing utilizing technology for supply chain optimization, enhancing efficiency from production to consumption using data, AI, and better logistics to prevent food loss. Digital tracking technologies are transforming food supply chain management from a reactive to a proactive system, enabling significant reductions in global food waste.

Keywords: food; waste; cost; solution; challenge.

Classification JEL: Q01, Q18, Q58, L66

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Introduction

The term *food waste* describes how edible food and inedible components (such as peels or bones) are disposed of in homes, restaurants, and retail establishments. This includes food that is spoiled, discarded due to cosmetic standards, or left unbought, as well as food thrown out by households and restaurants. It ranges from pre-harvest losses on farms to leftovers in consumers' homes.

It signifies a decline in both quantity and quality, frequently brought on by excessive purchases, inadequate storage, or aesthetic standards, leading to resource waste. The massive amount of edible food that is lost, ruined, or thrown away at every stage of the supply chain, from farms to homes, is known as the *food waste problem*.

Food waste generates greenhouse gasses in landfills while millions of people go hungry, making it a serious problem that causes enormous environmental damage, financial losses, and worldwide inequalities. Roughly 30-33% of global food production - amounting to 1.3 billion tons annually - is lost or wasted, equating to over 1 billion meals a day, yet one in nine people remains undernourished. Also, eight to ten percent of the world's annual greenhouse gas emissions come from food loss and waste. (UNEP, 2024), (UNFCCC, 2024). This article aims to present managerial possibilities for solving the global problem of food waste.

Literature Review

The literature dedicated to food waste issues is vast and can be divided into two groups: reports and other publications of official institutions (FAO, Ellen Macarthur Foundation, Geneva Environment Network, UNEP, UNFCCC, WEFORUM, WRI) and articles by various experts in the field addressed. In terms of essence, the presentation of the literature requires grouping the sources. The authors in the first group explain the essence and problems related to food waste (Geneva Environment Network, 2026), (Jangira Lewis, 2022), (Pyle, 2021), (Taste Before You Waste, 2019), (UNEP, 2024), (UNFCCC, 2024), (WEFORUM, 2026), (WFPUSA, 2026).

Other authors have examined a complex of determining interconnected drivers of food waste (Adam, 2015), (Liz Goodwin, 2025), (ReFED, 2026), (Veselá et al., 2023). The experts in the third group focused their research on solutions to global food waste (Aydinli et al., 2023), (Danish, 2025), (Davison, 2026), (European Commisision), (Fatorachian et al., 2025), (Foodunfolded, 2023), (Goodwin, 2025), (Mohammad, Mohammad, 2024), (Teixeira, 2025), (The Happy Turtlestraw, 2024). The authors from the fourth group examined the challenges in implementing food waste reduction solutions. (Fatorachian, 2025), (Malhotra, Vos, 2021), (Olabode, 2025), (Sarangi et al., 2024), (Sharma et al., 2023), (Smrttsolutions, 2024)

Methodology

The research was conducted based on open publications on the Internet. At the initial stage of the research, the systematic research method used to identify relevant literature by examining the reference lists (backward tracking) or citing articles (forward tracking) of foundational papers was used. Then, after selecting the most interesting and eloquent sources, the basic ideas of the topic addressed were grouped, distinguishing: the essence of the global problem of food waste, its multidimensional impact, important contributing factors, the managerial solutions practiced and the existing barriers. For each domain, the material was synthesized, and then compiled into a unique picture.

Results and Discussion

Food waste has become a major global problem that threatens sustainable development through its significant impact on the environment, economy and society.

Key environmental impacts can be formulated as follows (Geneva Environment Network, 2026), (Jangira Lewis, 2022):

- *Climate Change*: Methane, a greenhouse gas far more powerful than carbon dioxide, is produced when food waste decomposes in landfills. Every year, food waste causes about 3.3 billion tons of CO₂ equivalent emissions worldwide.
- *Water Waste*: Seventy percent of the freshwater used worldwide is used for agriculture. Water used for crop spraying, irrigation, and raising livestock is wasted when food is wasted.
- *Land Use & Biodiversity Loss*: Food waste accounts for over 28% of the world's agricultural land (1.4 billion hectares), which directly contributes to habitat destruction and decreased biodiversity.

- *Deforestation & Pollution:* Deforestation frequently results from the expansion of agricultural land. Furthermore, using pesticides and fertilizers needlessly contributes to the development of food waste.

The global economic impact of food waste can be examined in three dimensions:

- *Global and Local Financial Loss:* An estimated USD 1 trillion in economic losses are caused by food waste worldwide each year. Food that is never consumed is grown on 28% of the world's arable land. (UNEP, 2026) Food waste reduction is a crucial issue for both environmental and economic gain, with a \$14 return for every \$1 invested (WRI, 2017).
- *Business and Operational Losses:* Businesses, including restaurants and retailers, lose between \$780 billion and \$1 trillion annually due to unsold, uneaten, or spoiled food. (Galactic, 2025) Recent findings indicate that the expenses related to food waste throughout the supply chain account for 33% of total revenue. This global figure is projected to reach \$540 billion by 2026. Food waste is indeed a dual setback. Retailers face rising costs for inputs, labor, and logistics, while simultaneously discarding inventory that could have been sold. They incur higher expenses to stock food items, only to lose their complete value when those items remain unsold. According to some estimates the worldwide cost of food waste could soar to \$3.4 trillion by 2030. The shortcomings are especially apparent in high-value perishable goods. Projections for 2026 indicate that wasted meat could result in \$94 billion in lost value, while fresh produce and baked goods are expected to account for \$88 billion and \$67 billion in losses, respectively (WEFORUM, 2026).
- *Household and Retail Waste:* According to the 2024 UNEP Food Waste Index Report, roughly 1.05 billion tonnes of food were wasted in 2022, with 60% coming from households, 28% from food service, and 12% from retail. At the same time, 783 million people were affected by hunger and a third of humanity faced food insecurity (UNEP, 2024).

Food waste also has multiple ***social influences*** (Pyle, 2021), (Taste Before You Waste, 2019), (WFPUSA, 2026):

- *Food Insecurity and Hunger:* While millions struggle with hunger, vast amounts of food go to waste. Saving just a quarter of the food currently discarded could feed 870 million people.
- *Ethical Concerns and Resource Waste:* Throwing away food also means squandering the labor, water, energy, and land invested in its production.
- *Economic Strain on Households:* For consumers, this waste translates into substantial financial losses – Canadian households, on average, lose more than \$1,100 annually.
- *Health and Social Exclusion:* Limited access to healthy food contributes to poor health, and food insecurity often brings emotional distress, including shame and social isolation.
- *Environmental Injustice:* When food decomposes in landfills, it emits methane, a potent greenhouse gas that accelerates climate change - impacting especially vulnerable populations such as low-income communities and farm workers in developing countries.

- Over-exploitation of Resources: The demand for higher yields puts growing pressure on agriculture, contributing to water shortages and the decline of biodiversity.

Food waste has *a complex of determining interconnected drivers* (Adam, 2015), (Liz Goodwin, 2025), (ReFED, 2026), (Veselá et al., 2023):

1. **Household and Consumer Behavior.** This is the largest source, driven by over-buying, improper storage, excessive meal preparation, and throwing away leftovers. Poor planning and impulse buying by consumers are among the causes. Buying food without a plan or buying in bulk because of promotions leads to over-buying. Another cause is misunderstanding expiration date labels. Confusion between “best before” (safety) and “best before” (quality) dates lead to throwing away safe food. Some of the problems are related to storage and handling. Improper storage (e.g., improper refrigerator temperatures) leads to premature spoilage. Some problems are related to serving behavior. This includes serving large portions and not using leftovers.
2. **Retail and Food Service Sector.** Grocery stores often overstock their display cases to create an illusion of abundance, while strict cosmetic standards (based on appearance) result in perfectly edible fruits and vegetables being thrown away. That is, retailers reject products that do not meet rigid cosmetic standards (shape, size, color), even if they are nutritious. Also, worth mentioning are overstocking and display. Keeping shelves fully stocked to create an impression of “fullness,” which leads to spoilage of unsold products. Similarly, some problems are related to hospitality practices. Buffets, large menus, and in some cases, excess food prepared for tourists contribute greatly to waste.
3. **Supply Chain and Production.** Lack of cold chain infrastructure, inadequate storage technology and poor transportation lead to high spoilage rates, particularly in developing economies. In these regions, poor roads, limited cold storage (refrigeration) and inefficient transportation lead to significant losses before reaching the market. Some of the problems are related to harvesting challenges. Lack of labor, unfavorable market prices or inadequate harvesting technology can lead to crops being left in the field. Other problems are related to inadequate packaging, which can cause food to spoil more quickly, although excessive and rigid packaging can sometimes create various waste problems. Also, low retail prices of food can reduce its perceived value, making it cheaper for businesses to waste it than to manage it, while fluctuations in market prices can cause farmers to leave crops unharvested.

Economic solutions to global food waste include (European Commission), (Goodwin, 2025), (The Happy Turtlestraw, 2024):

- **Economic incentives for food donation:** Economic incentives for food donation include enhanced tax deductions, corporate tax credits, and government grants designed to encourage businesses to donate surplus food rather than disposing of it. These mechanisms reduce disposal costs and provide significant tax savings, with some regions offering deductions covering a percentage of the net book value of donated food. Many jurisdictions provide enhanced deductions, where businesses can deduct the cost of the food plus a portion of the potential profit. For instance, France and Spain allow 60% and 35% respectively of the net book value of donated food to be claimed as a corporate tax credit. (European Commission) Donating food allows businesses to avoid hefty landfill or waste-disposal fees. Financial grants are available for organizations investing in food, supporting the logistics and infrastructure of food recovery programs. While a legal

mechanism, safe food donation laws (e.g., the Emerson Act in the US) act as an economic incentive by removing the risk of litigation for donors, thus reducing the "risk cost" of donation. (The Network for Public Health Law)

- ***Investment in Cold Chain and Infrastructure:*** Investing in enhanced storage, transportation, and processing facilities (such as solar-powered dryers) greatly minimizes post-harvest losses, especially in developing areas. Investing in sustainable cold chain infrastructure – refrigerated storage, transportation, and monitoring - is essential for decreasing the nearly 40% of food wasted in developing regions. With the sustainable cooling market projected to reach \$600 billion by 2050, investments are directed towards minimizing post-harvest losses, boosting small-scale farmer income, and strengthening food security, particularly in Africa and India. (Davison, 2026), (FAO) These investments are essential not only for minimizing food waste but also for promoting environmental sustainability and aiding the livelihoods of small-scale farmers in developing areas.
- ***"Imperfect" Produce Markets:*** Farm-level waste is decreased by establishing markets and encouraging the sale of fruits and vegetables that are safe, wholesome, and visually flawed. "Imperfect" produce markets, also known as the "ugly produce movement," offer nutritious and safe fruits and vegetables that are turned down by regular supermarkets because of aesthetic flaws (size, shape, color). By sourcing directly from farmers, these markets cut down on food waste. They also serve customers who care about the environment by providing convenient, sustainable home delivery at lower prices. (Aydinli et al., 2023), (Foodunfolded, 2023) The use of these "quirky-looking" ingredients in processed foods, drinks, and spirits is also becoming more common in these markets, normalizing the consumption of non-uniform food.
- ***Digital Supply Chain Optimization:*** By using IoT sensors and digital twins, retailers can better manage inventory, track transportation, and keep an eye on food freshness, all of which reduce spoilage. In order to change the food supply chain from a reactive, linear process to a proactive, transparent, and responsive ecosystem, Digital Supply Chain Optimization (DSCO) makes use of cutting-edge technology, particularly the Internet of Things (IoT), artificial intelligence (AI), and blockchain. DSCO helps stakeholders reduce food waste, increase logistics efficiency, and improve food safety from farm to consumer by improving data visibility and predictive capabilities. (COM4, 2023), (Fatorachian et al., 2025), GEP (2023)
- ***Circular Economy Models:*** Food waste can be turned from a disposal expense into a source of income by being converted into value-added products like animal feed, biogas, fertilizer, or energy. By reducing, reusing, and recycling waste, circular economy models for food waste aim to close the nutrient loop and turn waste into resources. Important tactics that help achieve SDG 12 (Responsible Consumption and Production) by reducing waste include designing out waste, redistributing excess food, valorizing by-products, and composting. (Danish, 2025), (Ellen Macarthur Foundation, 2019), (Mohammad, Mohammad, 2024), (Teixeira, 2025), (UTS)

The main circular economy models for solving the problem of food waste are:

- *Circular Food Design:* utilizing by-products in new food products or optimizing packaging to increase shelf life as examples of designing food systems to reduce waste.

- *Redistribution and Sharing Economy*: selling extra food, giving it away, or sharing it (e. A g. platforms that link eateries with extra food to customers) to cut down on waste at the retail and consumer levels.
- *Valorization of By-products*: repurposing food waste by converting industrial food leftovers into high-value nutrients, animal feed, or bioenergy.
- *Organic Waste Recycling*: by replenishing the soil with nutrients through composting, ecosystems are restored and the food chain is closed.
- *Industrial Symbiosis*: a system that reduces waste and resource consumption by using waste from one food process as an input for another.

These models aim to transition from a linear "take-make-dispose" system to a regenerative one that minimizes environmental impact.

- ***Vertical Farming and Local Sourcing***: Putting hydroponic vertical farms right in stores cuts down on how far food travels and how much spoils, so it gets from being picked to your plate super-fast. When you grow food vertically and get it from local sources, it's a smart, high-tech way to really cut down on wasted food. This is because you get rid of those long shipping routes, make growing conditions just right, and make sure food gets from the farm to you almost immediately. By growing food inside in cities, this approach tackles the big problem that about a third of all the food we make goes to waste before it even gets to people, especially the stuff that goes bad quickly (Shypple, 2022).
- ***Data-Driven Waste Management***: Using digital tools and platforms to monitor food waste enables both businesses and households to measure, manage, and minimize losses more effectively. By leveraging AI, IoT sensors, and predictive analytics, data-driven approaches can reduce food waste by 20-45%, enhancing supply chain performance and streamlining inventory control. Companies analyze factors like sales trends, weather patterns, and consumer habits to fine-tune production, while smart kitchens use AI-powered visual recognition systems to automatically monitor and reduce waste – often lowering expenses by 3–5%. Compared to conventional methods, these data-based strategies not only cut waste significantly but also boost recycling precision above 90% and deliver annual cost savings of 15–25%. For instance, retailers apply AI to adjust prices dynamically, offering discounts on items nearing expiration to prevent spoilage. Smart sensors connected via IoT capture real-time environmental conditions, helping extend product shelf life and reduce waste by up to 10%. Machine learning models assess past sales, seasonal events, and weather to forecast demand more accurately, minimizing excess in both retail and kitchen operations. Mobile AI applications allow users to photograph leftovers and log waste, offering recipe suggestions based on existing ingredients to help reduce household food loss. Additionally, AI and sensor technologies assist in sorting waste streams, determining optimal reuse pathways such as composting, animal feed, or biogas production. (Arman et al., 2024), (Clark et al., 2025), (Eitfood, 2025), (Fatorachian, 2025), (Kayikci, 2022), (The climate drive), (Wu et al., 2025).

At the same time, the application of management technologies to reduce food waste faces certain challenges, the main ones of which include (Fatorachian, 2025), (Malhotra, Vos, 2021), (Olabode, 2025), (Sarangi et al., 2024), (Sharma et al., 2023), (Smrt solutions, 2024):

1. ***Economic and Financial Barriers***. The study identified three categories of economic and financial barriers. First, there is the need to bear high initial investment costs.

Implementing IoT sensors, AI-based management systems and advanced packaging is expensive, creating a high barrier to entry, especially for small and medium-sized enterprises (SMEs). Second, there is the low perception of return on investment. Many companies hesitate to invest due to uncertainty about the long-term amortization of these technologies. Third, there are significant operational costs. Maintaining smart systems, including software updates and staff training, imposes ongoing financial burdens.

2. ***Technological and Infrastructure Gaps.*** These can be divided into three groups. The first consists of data silos and integration issues. The lack of standardized data protocols means that the different technologies used within the supply chain often do not interact well, preventing perfect end-to-end traceability. The second group is linked to inadequate physical infrastructure. In developing regions, the absence of basic infrastructure - such as reliable cold chains, electricity or internet connectivity - limits the ability to adopt sophisticated technologies. And the third group are barriers formed by the variability of waste composition. Artificial intelligence systems designed to sort or process waste often struggle with the inconsistent and diverse nature of food waste, causing operational inefficiencies in automated systems.
3. ***Managerial and Organizational Challenges.*** These are diverse, starting with resistance to change. Company culture can be a significant barrier, with skepticism about the reliability of new technologies and a lack of skills to manage digital tools (e.g., IoT data analysis). Similarly, there is a lack of qualified personnel. There is currently a lack of expertise to design, implement and maintain digital food management systems. There is also limited cooperation. It is important to note that reducing food waste requires cooperation across the entire supply chain. However, low motivation for information sharing between actors - driven by the fear of a competitive disadvantage - restricts data sharing.
4. ***Regulatory and Policy Limitations.*** Serious obstacles to reducing food waste have become inconsistent or outdated waste management regulations that can slow the adoption of new and sustainable technologies, especially in the efficient recycling and reuse of food waste. Similarly, it is worth noting that strict regulations, often reluctant to enforce expiration dates, can hinder the adoption of smart technologies that could safely extend the shelf life of food, causing avoidable waste.

Conclusions

Food waste pertains to consumable food products that are thrown away, spoiled, or left uneaten at the retail or consumer stages (including households, restaurants, and shops). This phenomenon constitutes a significant sustainability challenge, as nutritious food is discarded rather than consumed, frequently as a result of overproduction, inadequate storage, or surpassing expiration dates. Solving the problem of food waste globally can allow for a substantial reduction in the problem of hunger and malnutrition. Minimizing food waste presents an essential chance to lower carbon emissions, save precious resources, and enhance food security. Tackling this challenge necessitates improving logistics, altering consumer habits, and increasing the redistribution of food to those who require it.

International practice has developed multiple solutions for reducing food waste. These include the implementation of the circular economy, economic incentives for food donation, vertical farming and local sourcing, investment in cold chain and infrastructure, overcoming

food market imperfections, digital supply chain optimization. Similarly, in the information age, data-driven waste management technologies can be of great help. The managerial activity of reducing food waste faces a series of obstacles of an economic, financial, managerial, organizational nature, technological and infrastructure gaps, as well as regulatory and policy limitations. Overcoming them is an important and complex task.

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REGIONALISATION OF EUROPEAN INTEGRATION IN THE REPUBLIC MOLDOVA: AN EXAMPLE OF INTERREGIONAL CONVERGENCE ALONG THE DNIESTER

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Abstract : *In the context of globalization and deepening integration processes within the European Union (EU), the Republic of Moldova is faced with the need to adapt its economic and social policies to EU standards. A central aspect of this process is the regionalization of European integration, which involves not only strengthening the role of central government but also the active involvement of regions in overall development processes. This article analyzes the transition from a centralized model of innovation management to a regional model using the example of six regions of Moldova. It examines the importance of integrating Moldovan regions into European research and innovation networks, participation in EU programs, and access to cross-border information spaces, which form the basis of Moldova's integration strategy into the EU. The paper utilizes theoretical approaches such as regional convergence theory, Porter's cluster development, intellectual specialization, and network economics theory, which serve as key tools for explaining and predicting regional integration processes. A comprehensive model is proposed to ensure interregional convergence and Moldova's integration into the European Community through innovative and research-based mechanisms that promote economic growth, social cohesion, and the development of local clusters. The study emphasizes that the active participation of regions in these processes is essential for Moldova's successful and effective accession to the EU.*

Keywords: *regionalization, integration, EU, innovation, research networks, cross-border data, cluster development.*

JEL classification: O18, R11, O52

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1. Introduction

In the context of globalization and deepening integration processes within the European Union (EU), the Republic of Moldova faces the need to adapt its economic and social policies to EU standards. A central aspect of this process is the regionalization of European integration, which implies not only strengthening the role of central government but also the active involvement of regions in overall development processes. The aim of this study is to analyze the transition from a centralized model of innovation management to a regional model using the example of six regions (Republic of Moldova, 2017) of Moldova, including the North, Center, South, and Transnistria. The focus is on interregional convergence along the Dniester River (Republic of Moldova, 2026), the integration of Moldovan regions into European research and innovation networks, participation in EU programs, and access to cross-border information flows. The research questions of the article:

1. How are Moldova's regions integrating into European innovation and research networks?
2. What methodological tools and strategies facilitate interregional convergence?
3. How does regional participation in EU programmes impact economic growth, social cohesion and cluster development?

2. Literature Review

The theoretical approaches to regional integration in contemporary research are based on several key concepts that define the mechanisms and patterns of integration processes:

- **Regional convergence theory** (Arvanitopoulos & Lazarou, 2023), explaining the trends of equalization of economic levels between regions.
- **Cluster development according to Porter** (Porter, 1998), focusing on industry concentrations and collaborative innovation.
- **Smart Specialization Strategy (S3)** (Foray, 2025), aimed at identifying the unique competitive advantages of regions.
- **Network economics theory** (Lombardo & Pasotti, 2004), which explains how interregional and cross-border connections influence innovative development.

Research by the JRC and the European Commission on **interregional cooperation and intellectual specialization** highlights the importance of such collaboration for lagging regions (Woolford et al., 2021). The key question is not only “how” to cooperate, but also “when” to include regions in joint projects to ensure maximum convergence and the effective exploitation of innovative opportunities. In this context, the timing and sequencing of cooperation initiatives play a crucial role in maximizing their impact, while alignment with smart specialization priorities strengthens the integration of regions into broader European innovation ecosystems.

Driving forces and factors of interregional cooperation are reflected in different types of proximity that influence the effectiveness of interregional interaction (Lalrindiki & O’Gorman, 2018), including *geographical proximity*, which facilitates personal contacts and the exchange of tacit knowledge; *functional proximity*, characterized by a similar technological level and industrial structure of enterprises; *relational or institutional proximity*, based on shared norms, laws, and cultural codes; and *cognitive proximity*, referring to a common knowledge base and scientific competencies, where a moderate level is considered optimal for innovation generation. These approaches form the basis for assessing interregional convergence in Moldova, making it possible to identify the key factors influencing the integration of regions into European networks and to design more targeted and effective cooperation strategies.

3. Methodology

The methodological approach of this study is based on a combination of complementary quantitative and qualitative methods, which allows for a comprehensive assessment of the impact of international support and investment mechanisms on regional development. The analysis utilizes the RHOMOLO (Di Comite et al., 2016) spatial model to assess regional convergence and policy effectiveness; a multiplier model to determine the economic impact of investments; an innovation activity index to measure the ability to transform external support into real innovation; an entrepreneurial discovery process (EDP) approach to identify unique market niches; and an analysis of proximity factors (geographical, functional, relational, and cognitive), which helps identify barriers and potential for interregional cooperation. The methods include:

1. **Spatial model RHOMOLO** to analyze regional convergence and policy effectiveness.
2. **Multiplier model** to assess the economic impact of investments
3. **Innovation Activity Index** to assess the effectiveness of the transformation of international support into real innovations:
4. **entrepreneurial discovery (EDP)** to identify hidden market niches and unique opportunities in each region.
5. **Analysis of proximity factors** (geographical, functional, relational and cognitive) to assess barriers and potential for interregional cooperation.

The methodology allows for the integration of quantitative data (GDP, structure of entities, innovation indices) and qualitative observations (interviews, expert assessments, institutional analysis).

4. Results and Discussion

4.1 Historical and modern approaches to regionalism and their limitations

Between the 1960s and 1980s, many researchers and policymakers assumed a universal "model" of regionalism applicable to all developing countries. However, the experience of the European Union demonstrated that this hypothesis failed to account for the specificities of individual regions and institutional systems. Most scholars focused on individual territories and countries, neglecting cross-regional comparative studies - a phenomenon Thompson (footnote 30) characterized as "region-centricity."

The political and historical context of regionalism (Behr & Jokela, 2011) was widely recognized as fundamental. Consequently, different regions were considered too diverse for direct comparison. The scholarly avoidance of interregional comparisons encouraged the proliferation of new concepts or the idiosyncratic use of existing ones that assessed only the specificities of individual regions. Rather than seeking to generalize knowledge and derive universal principles, research remained localized, limiting itself to analyzing a single region or individual cases of cooperation. This "local" tradition in regional studies fostered fertile ground for parochialism, which largely echoes Problem №1, characteristic of EU studies (footnote 31). In this context, regional initiatives were perceived as unique and poorly comparable, limiting the possibility of developing integrative strategies for cross-border or neighboring territories.

Nevertheless, modern approaches to regionalism emphasize the need to consider both the internal specifics and external connections of regions. For Moldova and its regions along the Dniester, this means that a convergence strategy cannot be limited to centralized resource allocation mechanisms; it must rely on interregional and cross-border instruments that take into account the institutional, economic, and innovative differences between the North, Center, South, and Transnistria. To realize the potential of the Convergence Fund and ensure the effective allocation of resources between regions, it is necessary to rely on the Smart Specialization Strategy (S3) methodology and modern spatial analysis models. This integrated approach combines quantitative and qualitative methods, enabling the convergence of regions at the economic, institutional, and innovative levels. To compare Moldova's regions with those of the EU and OECD countries, it is necessary to use a methodology that takes into account both economic and institutional differences. Simple aggregate indicators of GDP or the

number of enterprises do not capture the complex interactions between regions, their innovative activity, and the impact of policy decisions on economic growth. In this context, spatial general equilibrium models provide researchers with a tool for complex analysis, allowing them to quantitatively predict the consequences of different resource allocation strategies and assess the effectiveness of interregional coordination.

To unlock new opportunities in the area of "Smart specialisation", regions and countries must analyse their position within European and global value chains. Based on this analysis, "Smart specialisation" strategies should be coordinated not only with national priorities and programmes, but also with regions in other countries, as no single region has complete and comprehensive information on all cooperation opportunities at the regional, national and European levels in their areas of "Smart specialisation". Consequently, the development of effective policies requires the development of targeted transregional cooperation that takes into account the distribution of administrative responsibility, risk management and the delineation of powers between participants. In this context, there is a need to use analytical tools that can take into account interregional interconnections, institutional differences and the spatial structure of the economy, which allows for a transition from descriptive analysis to quantitatively substantiated modelling of convergence processes.

4.2 Spatial model RHOMOLO

To compare Moldova's regions with those of the EU and OECD countries, it is advisable to use the spatial general equilibrium model RHOMOLO. This model allows:

- evaluate the effectiveness of regional policy management;
- to analyze the dynamics of regional convergence in the EU and neighboring countries;
- to quantitatively predict the impact of institutional changes and investments on economic growth.

RHOMOLO enables the modeling of resource allocation scenarios and assessment of their impact on the economic performance of individual regions, and goes beyond quantitative assessment. The model also allows for the identification of potential imbalances between regions, the assessment of the impact of institutional reforms and investment initiatives on innovation dynamics, and the prediction of how coordination and targeted resource allocation can contribute to the convergence of the economic and technological levels of the Northern, Central, Southern, and Transnistria regions. Combined with the Smart Specialization (S3) strategy tools, RHOMOLO provides an analytical basis for the Convergence Fund's strategic planning and the formulation of long-term recommendations for the development of interregional clusters and innovation chains.

4.3 Quantitative assessment of the investment effect

After spatially assessing the regions, it is important to determine which investments will yield the greatest economic impact. For this purpose, a multiplier model is used, which takes into account the propensity to consume and the tax base of regions. Differences in income levels and infrastructure development across regions require a targeted approach to distributing the Fund's resources. This can be accomplished using a multiplier model, which allows for assessing the overall economic impact of investments:

$$Y = \frac{1}{1-c(1-t)} \times I \quad (1)$$

Where:

- Y is the total economic effect of investments;
- c - propensity to consume (e.g. 0.6);
- t - business tax rate (e.g. 0.2);
- I - the amount of initial investment (for example, 1,625,000 MDL – the amount of the grant and co-financing).

Example of calculation. Input data: I = 1,625,000 MDL; c = 0.6; t = 0.2.

Calculation:

$$Y = \frac{1}{1 - 0.6(1 - 0.2)} \times 1,625,000 = \frac{1}{1 - 0.6 \times 0.8} \times 1,625,000$$

$$= \frac{1}{1 - 0.48} \times 1,625,000 = \frac{1}{0.52} \times 1,625,000 \approx 3,125,000 \quad (2)$$

The multiplier model allows us to assess which regions (for example, the agricultural North or the industrial Center) will have the greatest impact on economic growth, taking into account regional consumption patterns and tax burdens. Thus, it ensures the rational allocation of Convergence Fund resources, taking into account the multiplier effect on local economies.

Interpretation of the result: this means that an investment of MDL 1,625,000 generates a cumulative economic impact of approximately MDL 3,125,000. This represents a nearly twofold multiplier effect, confirming the high efficiency of investments in the Moldovan economy and its SME sector.

4.4 Assessment of innovative and intellectual capital

The next step in bridging the innovation gap is to assess the ability of regions to transform investments into innovation and new technologies. This is done using an innovation activity index, which takes into account both the number of joint projects and their degree of novelty:

$$I = \frac{\text{number of joint projects} \times \text{degree of innovation}}{\text{total number of projects in the region}} \quad (3)$$

- I = index of regional innovation activity;
- Number of joint projects - the number of projects with international or interregional participation;
- Degree of innovativeness – an indicator of novelty (for example, the introduction of new technologies, R&D components, etc.);
- Total number of projects in the region - total number of projects being implemented.

The use of this index allows:

- identify regions that effectively use international support to create innovative products;
- identify the potential for the formation of clusters integrated into European research networks;
- plan strategic investments of the Convergence Fund to strengthen the innovative potential of less developed territories.

The use of the innovation activity index complements spatial and economic assessment, providing a comprehensive analysis of the innovative and intellectual capital of regions.

4.5 Entrepreneurial Discovery Process (EDP)

Quantitative models and indices provide only a partial picture of a region's potential. To identify hidden opportunities and niche advantages, the entrepreneurial discovery process (EDP) (Perianez Forte & Wilson, 2021) is used. This method is based on:

- active dialogue with business, science and local authorities;
- identification of new market niches;
- development of strategies aimed at integrating regions into global value chains.

The EDP is particularly important for "lagging regions" (the South and Transnistria), where traditional GDP and employment indicators fail to capture the hidden potential for innovation. The method helps regions determine when and how to engage in interregional cooperation, minimizing the risk of ineffective investments and enhancing convergence.

4.6 Intimacy factors

An important dimension of interregional cooperation is the role of proximity - referred to here as intimacy factors - which determine the intensity and effectiveness of interactions between regions. In this context, several types of proximity shape the conditions for successful collaboration and innovation exchange:

1. **Geographical proximity**- support of personal contacts and cross-border information flows that facilitate the exchange of tacit knowledge;
2. **Functional proximity** - compatibility of technological levels of enterprises and industry structures;
3. **Relational/Institutional Proximity** - harmonization of norms, rules and cultural codes;
4. **Cognitive proximity** - a level of common knowledge that ensures effective exchange of experience and innovation.

Analysis of these factors allows us to:

- to identify barriers to cooperation between regions;
- to identify the potential for joint development of innovative clusters;
- to stimulate socio-economic rapprochement between the Northern, Central, Southern regions and Transnistria.

4.7 The prospect of "lagging regions"

Building on the previously discussed analytical tools - such as the RHOMOLO model, multiplier effects, innovation indices, and proximity factors - it becomes essential to focus specifically on regions that demonstrate comparatively lower levels of economic and innovation development. These "lagging regions" require tailored policy approaches, as their integration into interregional and European networks presents both significant challenges and unique opportunities for accelerating convergence. The S3 Strategy places special emphasis on "lagging regions," focusing on "how and when" they should engage in interregional cooperation to maximize convergence. For the South and Transnistria, this means:

- identifying unique niches for "smart specialization";
- integration of regions into European networks;
- stimulating entrepreneurial discovery to identify competitive advantages.

Thus, the strategic inclusion of lagging regions into interregional cooperation frameworks not only enhances their individual development trajectories but also contributes to the overall cohesion of the national economic system. To operationalize these objectives and ensure evidence-based policy implementation, it is necessary to complement strategic approaches with robust analytical tools. In this context, the application of both quantitative and qualitative mapping methods becomes a critical next step for identifying regional potential and guiding investment decisions.

4.8 Application of quantitative and qualitative mapping

Quantitative mapping - this analysis includes GDP dynamics and the distribution of economic entities to identify industry leaders. It allows us to determine where investments will have the greatest multiplier effect. **High-quality mapping** is based on the entrepreneurial discovery process (EDP). This mechanism involves:

- active dialogue with business and scientific organizations;
- identifying hidden market opportunities;
- assessment of proximity factors and potential for interregional cooperation.

The combination of quantitative and qualitative mapping provides a comprehensive assessment of the potential of regions along the Dniester and forms the basis for the strategic allocation of resources of the Convergence Fund.

4.9 Integration into macro-regional strategies

Sustainable development of macro-regions, such as the Danube Strategy and the Baltic Sea Region Strategy, reduces uncertainty and promotes internal and external convergence:

1. **Formation of critical mass and synergy of efforts:** transnational cooperation pools resources and knowledge, creating the necessary critical mass for global competitiveness;
2. **Uncertainty Reduction through EDP:** the participation of business and science in determining investment priorities minimizes the risk of errors and government dirigisme;
3. **Harmonization through proximity factors:** institutional, functional and cognitive proximity reduce barriers and accelerate innovative collaboration;
4. **Coordination to prevent duplication:** macro-regional frameworks allow for the identification of unique specializations and the avoidance of competition on identical technologies;
5. **Using RHOMOLO analytical models:** quantitative assessment of policy effectiveness and forecasting the dynamics of regional convergence.

Thus, the integration of the Republic of Moldova's development regions with the regions of the countries of the Danube Strategy Macroregion (European Commission, 2021) (*Danube*), the Baltic Sea (European Commission, 2021a) (*Baltic*), and the Alpine Macroregion

(European Commission, 2021b) (Alpine) transforms geographic proximity into a strategic partnership, creating a predictable environment for investment, accelerating socio-economic convergence, and integrating into European innovation networks.

Conclusions

1. **The role of regions in European integration:** Moldova's successful integration into European networks is impossible without the active participation of regions in innovation and research projects.
2. **The effectiveness of interregional convergence:** the use of S3, RHOMOLO, and the multiplier tools allows us to evaluate and strengthen the convergence of regions in terms of economic and innovation indicators.
3. **Removing barriers:** the harmonization of norms, the development of institutional and cognitive proximity, and the process of entrepreneurial discovery reduce the differences between the North, Center, South and Transnistria.
4. **Practical recommendations:** the Convergence Fund should strategically invest in innovative projects, create clusters, and stimulate the participation of “lagging regions” in international initiatives.

Contribution of the study: the article demonstrates how the combination of quantitative and qualitative analysis, proximity factors and interregional strategies can contribute to the sustainable integration of Moldovan regions into the European economic and innovation space.

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MARKETING ORIENTATION IN UNIVERSITIES AS A FUNDAMENTAL RESOURCE FOR GAINING SUSTAINABLE COMPETITIVE ADVANTAGES

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Abstract: *The growing competition in higher education forces universities to adopt a marketing orientation as a strategic approach to enhance institutional performance and achieve sustainable competitive advantages. The paper presents the results of a study of the level of marketing orientation of universities in the Republic of Moldova, based on a survey of university leaders, rectors, vice-rectors and heads of marketing departments. The results show that respondents are aware of the importance of marketing to improve the image, attractiveness and success of the institution. The study points out the necessity to upgrade the internal marketing capabilities, increase the use of modern marketing tools and integrate marketing thinking into the institutional management. Such measures can contribute to enhancing the competitiveness and long-term sustainability of universities in the increasingly dynamic higher education sector.*

Keywords: *university marketing, higher education, competitiveness, sustainable competitive advantage*

Classification JEL: M31, I23, L25

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1. Introduction

The new context in which higher education institutions around the world operate requires university management based on the incorporation of marketing principles and practices, defined as a marketing orientation, which many authors have termed “market orientation” or “customer orientation.”

In the specialized scientific literature, the need for market orientation is sufficiently well-argued as a key strategic imperative for improving the performance of for-profit organizations and a strategic necessity for survival in hostile environments, where market turbulence and competitive rivalry are high, as a fundamental resource for creating sustainable competitive advantages in the effort to compete effectively (Crick, 2021; Lafferty & Hult, 2001; Van Raaij & Stoelhorst, 2008). Based on their analyses, Niculescu et al. (2013) defined marketing orientation as a cultural process within any organization for the consistent creation of superior value for the customer, based on market information. At the same time, they highlighted a series of advantages for commercial enterprises resulting from their market orientation, including: company profitability, it represents a more effective means of identifying customer needs, it ensures an increase in perceived value and customer loyalty, it creates effective means of gaining competitive advantages, it enables more effective innovation in the service sector, it

represents improved organizational commitment in the public sector, can ensure increased success for new products and improved partnerships with suppliers, can motivate employees to serve customers more effectively, and can help improve leadership capabilities and retain more profitable customers. Zebal and Goodwin (2012) also note the positive relationship between market orientation and performance by offering additional value to buyers, thereby creating a competitive advantage and better profitability.

2. Literature Review

Over the years, numerous studies in the fields of management and marketing have also highlighted the importance of developing a marketing orientation in nonprofit organizations. Thus, Voss and Voss (2000) addressed the issue of market orientation in the arts and culture sector; Wood et al. (2000) - in the health sector; Drummond et al. (2000) analyzed certain aspects related to the market orientation of a public service; Vázquez et al. (2002) analyzed the strategies used by various nonprofit organizations to orient their activities toward the market. In this context, numerous studies (Glaveli & Geormas, 2018; Khuwaja et al., 2019) have demonstrated that there is a positive impact of marketing orientation on the performance of public/nonprofit organizations, despite the fact that it is derived from for-profit organizations.

The cultural perspective on market orientation in higher education institutions is presented in the work by Oplatka and Hemsley-Brown (2007), “The incorporation of market orientation in the school culture. An essential aspect of school marketing” (p. 293), which defines it as a set of values and beliefs that prioritize the interests of clients, while simultaneously increasing the university’s awareness of the need to gather information about competitors and establish interdepartmental activities to meet customer needs, in order to gain a competitive advantage in a turbulent and competitive environment.” In another paper by the same authors, titled “Market orientation in universities” (Hemsley-Brown & Oplatka, 2010), the authors suggest the following three interrelated components of market orientation in universities:

1. Customer (student) orientation, which implies that faculties have a detailed understanding of the universities’ target markets and are capable of creating and delivering superior long-term value. This requires the continuous collection of information about the environment in which students live, the adoption of teaching methods to meet students’ specific needs, greater responsiveness to their interests and viewpoints, the implementation of innovations and improvements for current and future students, etc. Based on the above arguments, Alarcón-del-Amo et al. (2016) believe that universities can secure competitive advantages, including in terms of reputation, by adopting a proactive marketing approach toward all the stakeholders mentioned above.
2. Competition orientation, which implies that the higher education institution and faculty managers aim to fully understand the strengths and weaknesses of competing higher education institutions, their capabilities and potential, and to monitor developments at rival universities, etc., which can have a positive impact on the decision-making process. At the same time, Brandenburger and Nalebuff (1996) argue that for higher education, a shift from “competitor orientation” to “co-competitor orientation” would be more appropriate, insofar as the relationship with competitors in the field of higher education differs from that in the business sector, as universities are simultaneously inclined toward collaboration and the development of partnerships with other universities.

3. Cross-functional coordination, which requires a fundamental conviction shared by all members of the higher education institution, the engagement of all departments and subdivisions, and the entire university community to better serve the needs and expectations of students, for which full access to all information about the university's market environment (competitors, the community at large, etc.) is necessary.

In line with the concept of economic, social, and environmental sustainability, Abou-Warda (2014) proposed a model of sustainable market orientation. This model incorporates a social marketing approach that takes into account the well-being of society, including stakeholders (students, faculty, other categories of employees, the community, competitors, recruitment firms, and the media), an ecological/environmental orientation, an orientation toward innovation, and an approach to co-creating sustainable value, reflecting the role of higher education institutions in supporting value-creation processes for students.

Numerous studies have demonstrated that a marketing orientation must be adopted by universities in order to increase overall performance and gain a competitive advantage (Hemsley-Brown & Oplatka, 2006; Ng, 2016), as it is considered an effective means of developing the student-university relationship due to the university's greater capacity to meet students' needs (Bakar et al., 2014; Voon, 2008) and, above all, their ability to enter the labor market more effectively (Clark et al., 2017). One way a university can increase its competitive advantage in the higher education market is to build a sustainable and attractive image in the eyes of applicants – to distinguish itself from other universities and make applicants want to be admitted.

Based on the analyzed specialized scientific literature, the definition of marketing orientation in universities can be proposed as a culture and specific behaviors shared by all university departments, manifested in a set of activities, methods, and techniques necessary for a deep understanding of the needs of current and prospective students, as well as those of other stakeholders and society as a whole, and finding ways to continuously adapt to their needs and requirements in an innovative and sustainable manner. In this context, and given the rapidly intensifying competition in the higher education services market at the global, regional, and local levels, universities must base their marketing policies on the presence of competition, their strengths and weaknesses relative to competing universities, and strategic and tactical decisions, the entire marketing toolkit, as well as marketing programs and plans, must simultaneously be oriented toward ensuring and developing competitive advantages and the university's overall competitiveness. Based on the above, it is considered that universities can succeed in achieving these outcomes by initiating and adopting market-oriented activities, which makes the implementation of a marketing orientation a proposal that university managers should consider. It is also natural that marketing orientation is only one of the factors that can lead to universities achieving these performance goals.

2. Methodology

In order to assess the marketing orientation of universities in the Republic of Moldova, an opinion survey was conducted among all universities in the country (19 in total at the time of the study) with a single follow-up, by requesting the completion of an online questionnaire, with respondents being individuals in leadership positions at all universities (rectors, vice-rectors, heads of marketing departments). This research involved transposing the questionnaire's questions onto an online platform and sending respondents the link to access it via email. Each email contained a message specifying the purpose of the research and a request to complete the

questionnaire by clicking the link included in the message. Email addresses were obtained by visiting the universities' websites using the Google search engine. The cover letter stated that the names of the universities and the individuals who completed the questionnaire would not be disclosed in subsequent publications. The questionnaire contained 34 items, with opinions measured using attitude scales (semantic differential, Likert scale).

3. Results and Discussion

It is worth noting that most universities attributed a very significant (63.2%) or significant (31.6%) role to university marketing activities in ensuring the institution's success, while a small proportion (5.3%) considered the impact to be minor (Fig. 1). This result demonstrates that in the Republic of Moldova, there is a strong awareness of the role of educational marketing in strengthening the image and attractiveness of universities.

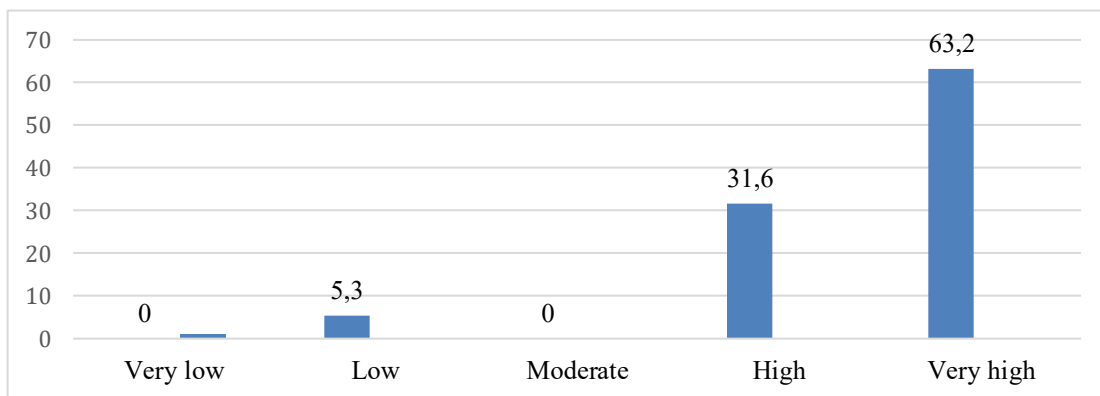


Figure 1. Universities' perceptions of the role of university marketing activities in ensuring institutional success

Source: prepared by the authors based on the results of the research conducted

It is also essential for universities in the Republic of Moldova to recognize the importance of marketing as a factor in strengthening the university's image and increasing its appeal to prospective students. Thus, the majority of universities (68.4%) considered this to be very important, 26.3% considered it important, and 5.3% considered it neither important nor slightly important (Fig. 2)

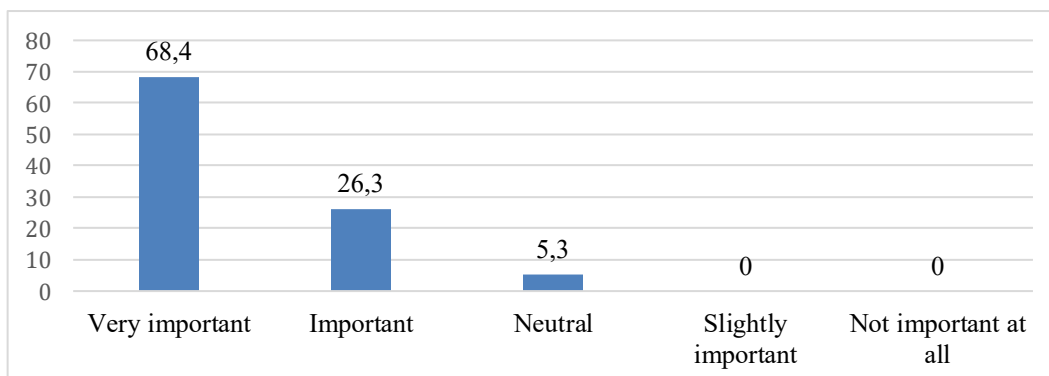


Figure 2. The importance of university marketing activities in strengthening the university's image and increasing its appeal

Source: prepared by the authors based on the results of the research conducted

Regarding the frequency of marketing activities, the majority of universities (68.4%) indicated that they conduct marketing activities aimed at increasing their appeal to prospective full-time students, 21.1% do so only occasionally, and 10.5% - only during the period leading up to the admissions process (Fig. 3). The findings above indicate a high level of university involvement in marketing activities, but also a more fragmented approach, in the sense that these activities are organized primarily or exclusively during the admissions period.

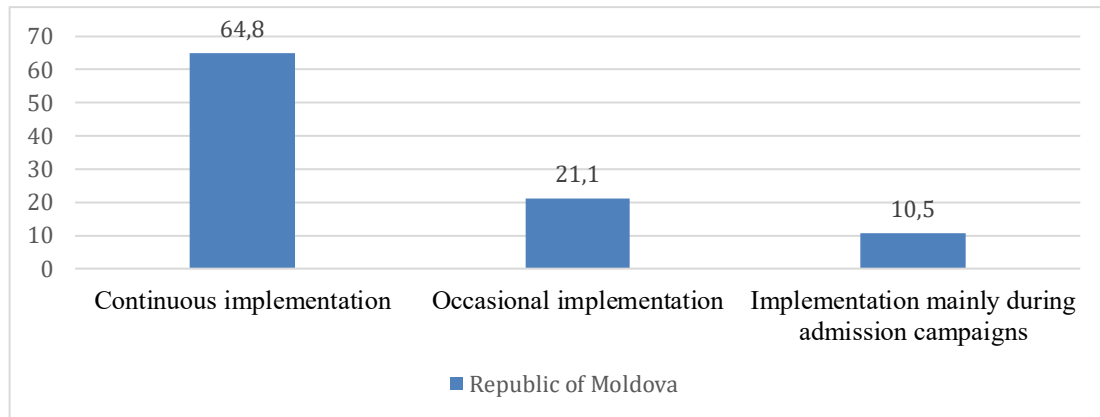


Figure 3. Frequency of marketing activities organized by universities in the Republic of Moldova to increase their appeal to prospective students

Source: prepared by the authors based on the results of the research conducted

The same number of universities (68.4%) indicated that they also carry out marketing activities aimed at improving the university's image among the general public and prospective students on an ongoing basis, which reflects the universities' constant concern with enhancing institutional visibility. However, a significant percentage (31.6%) carry out such activities only occasionally, indicating the lack of a unified and continuous marketing strategy at a relatively large number of universities (Fig. 4).

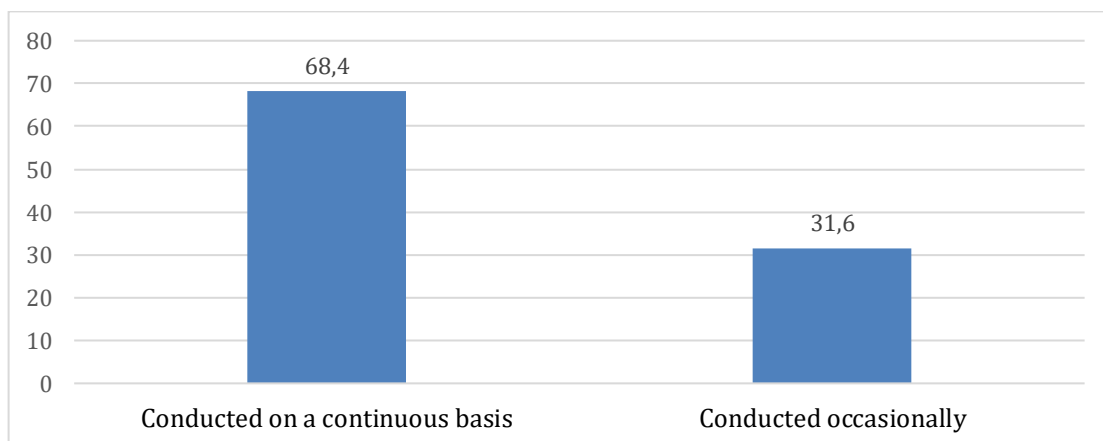


Figure 4. Level of involvement in university marketing activities aimed at promoting the institutional image

Source: prepared by the authors based on the results of the research conducted

As noted above, a marketing orientation in university operations requires cross-functional coordination, which in turn requires a fundamental conviction shared by all members of the higher education institution - namely, the promotion of a marketing mindset (philosophy)

among all employees. In this context, it is worth noting that only 10.5% of universities identified the adoption of university marketing thinking as a philosophy as a priority, while the vast majority (89.5%) consider the practical application of the modern concept of university marketing to be more important, suggesting a pragmatic orientation focused on concrete solutions and tools, applied only by the responsible personnel within marketing departments, where such departments exist (Fig. 5). These results suggest the need for a shift in attitudes within universities through the adoption of an appropriate marketing philosophy among all staff and a shift in thinking from a product-oriented approach (academic programs) toward a more customer- and stakeholder-centered approach.

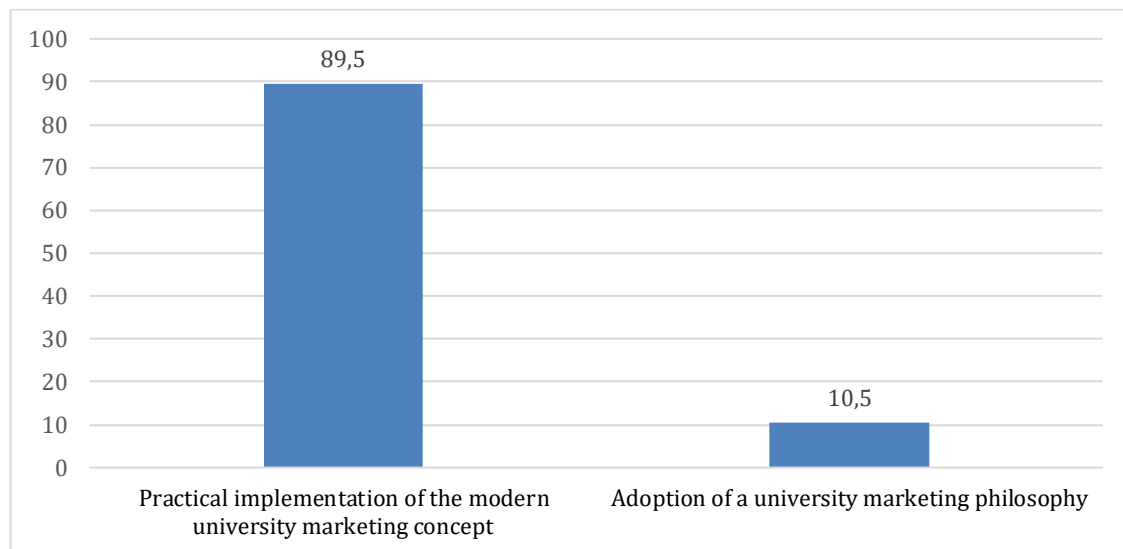


Figure 5. Aspects considered priorities in the implementation of university marketing in higher education institutions in the Republic of Moldova

Source: prepared by the authors based on the results of the research conducted

University marketing activities can be organized both using the universities' own resources and through outsourcing, that is, by engaging entities specialized in providing marketing services and consulting. Thus, the research results showed that in these activities, only 36.8% of universities rely on their own staff, 57.9% rely on their own staff but also collaborate with marketing service providers, and 5.3% rely solely on specialized companies (Fig. 6). Although the data above demonstrate an openness on the part of universities to collaborate with specialized companies in the field, which generally possess a high level of professionalism in the field, they may have less knowledge regarding the content of the concept of university marketing, the behavior of internal and external clients in the field of higher education, as well as the internal marketing environment of universities. At the same time, the tendency toward outsourcing marketing services may also indicate a lack of sufficient marketing capabilities within universities.

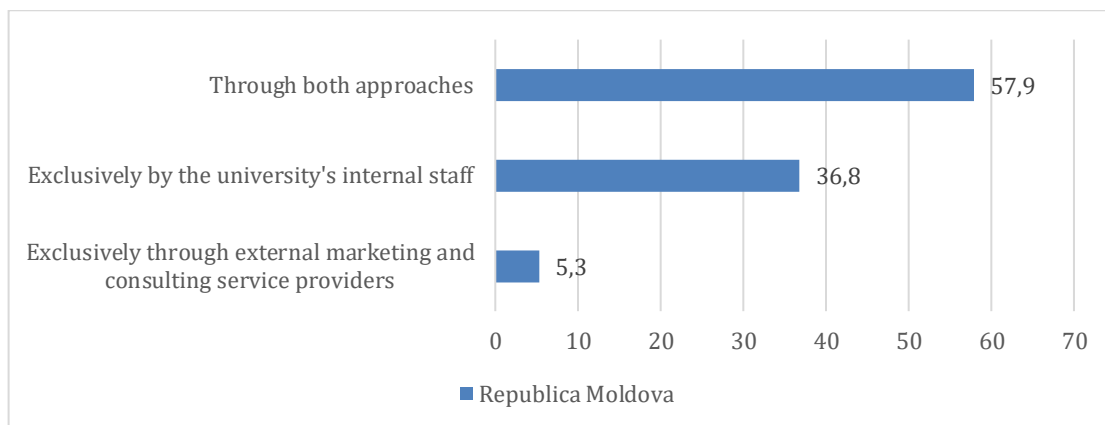


Figure 6. Methods of organizing marketing activities within universities

Source: prepared by the authors based on the results of the research conducted

The data above also correlates with the presence of marketing departments within universities in the Republic of Moldova. Thus, only 47.4% of universities reported that they already have a specialized marketing department incorporated into the university's organizational structure, with varying names and levels of autonomy; 21.1% intend to create one, and 31.6% of them do not have one at all (Fig. 7). This demonstrates that a fairly large number of universities do not, at least for the time being, have a formal structure dedicated to these activities.

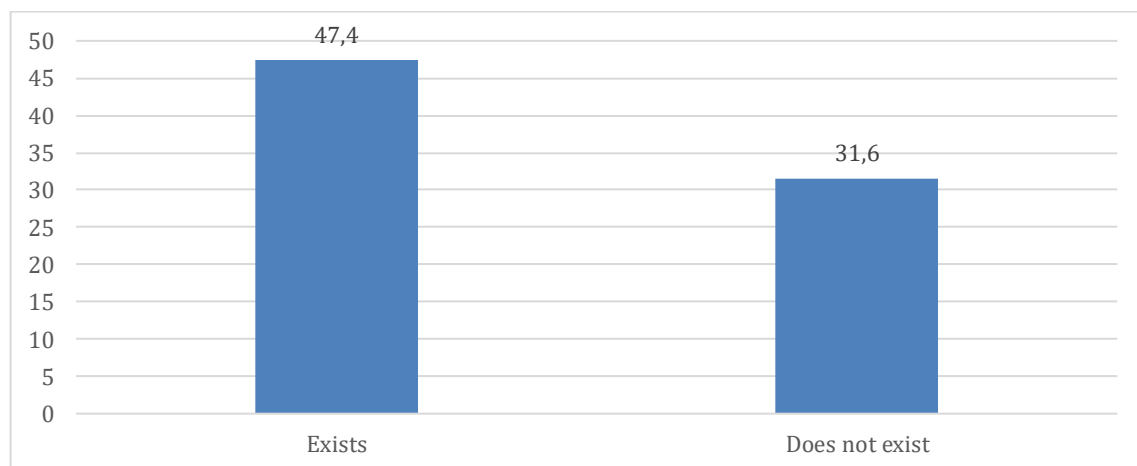


Figure 7. Establishment of a specialized marketing department within universities in the Republic of Moldova

Source: prepared by the authors based on the results of the research conducted

The study also demonstrated that in the Republic of Moldova, the coordination of marketing activities falls largely to the university rector (52.6%), which indicates a strong centralization of strategic decisions. Some universities (21.1%) noted that this responsibility falls to a vice-rector, while 15.8% designated a head of the marketing department as the primary coordinator. At the same time, 10.5% of universities believe that marketing does not require formal coordination, leaving it to the discretion of those carrying it out. (Fig. 8) This distribution suggests a variety of governance models, but also indicates that, in many cases, university marketing remains an activity managed at the top management level rather than through specialized structures.

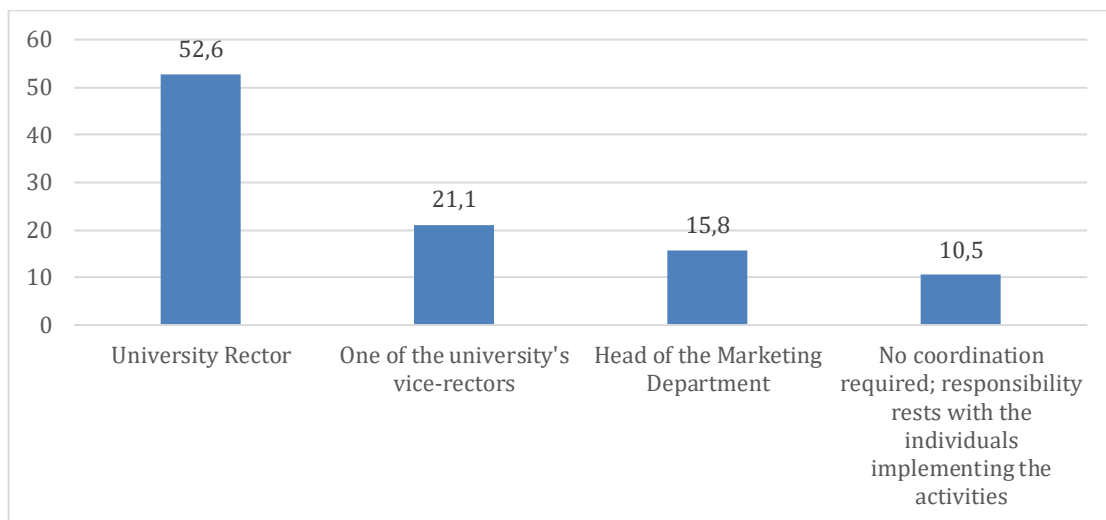


Figure 8. Responsibilities for coordinating marketing activities at universities in the Republic of Moldova

Source: prepared by the author based on the results of the research conducted

The marketing orientation of universities involves the development and implementation of relevant strategies so that higher education institutions can achieve their institutional goals, including those related to image, reputation, and attractiveness, as well as cope with the constant changes occurring in the environment in which they operate.

In this context, the studies conducted highlighted that the majority of universities (52.6%) indicated that they do not have a distinct marketing strategy, and that marketing activities are integrated into the university's strategic development plan; another 42.1% of universities indicated that a strategy exists, developed through the content of the university's strategic development plan; and only 5.3% indicated that there is a distinct marketing strategy, separate from other institutional strategic development documents (Fig. 9).

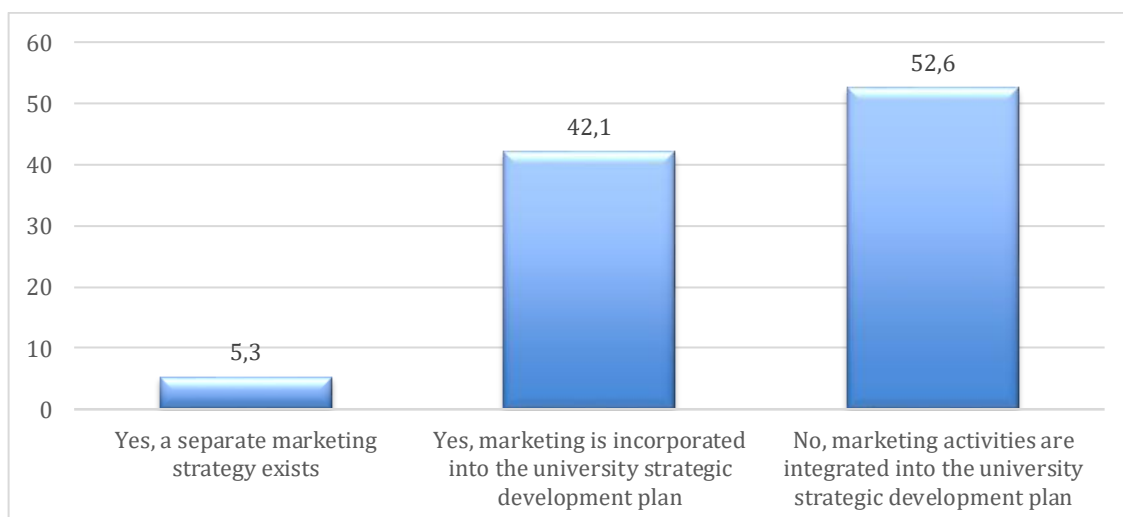


Figure 9. Alternatives for strategic marketing planning at universities in the Republic of Moldova

Source: prepared by the authors based on the results of the research conducted

The above findings allow us to conclude that for universities in the Republic of Moldova, strategic university marketing is in its early stages and, as a rule, involves a series of activities designed to attract high school graduates, often using simple forms of traditional marketing, aimed at building and strengthening the best possible image of the universities and their study programs, as well as differentiating them from their main competing universities.

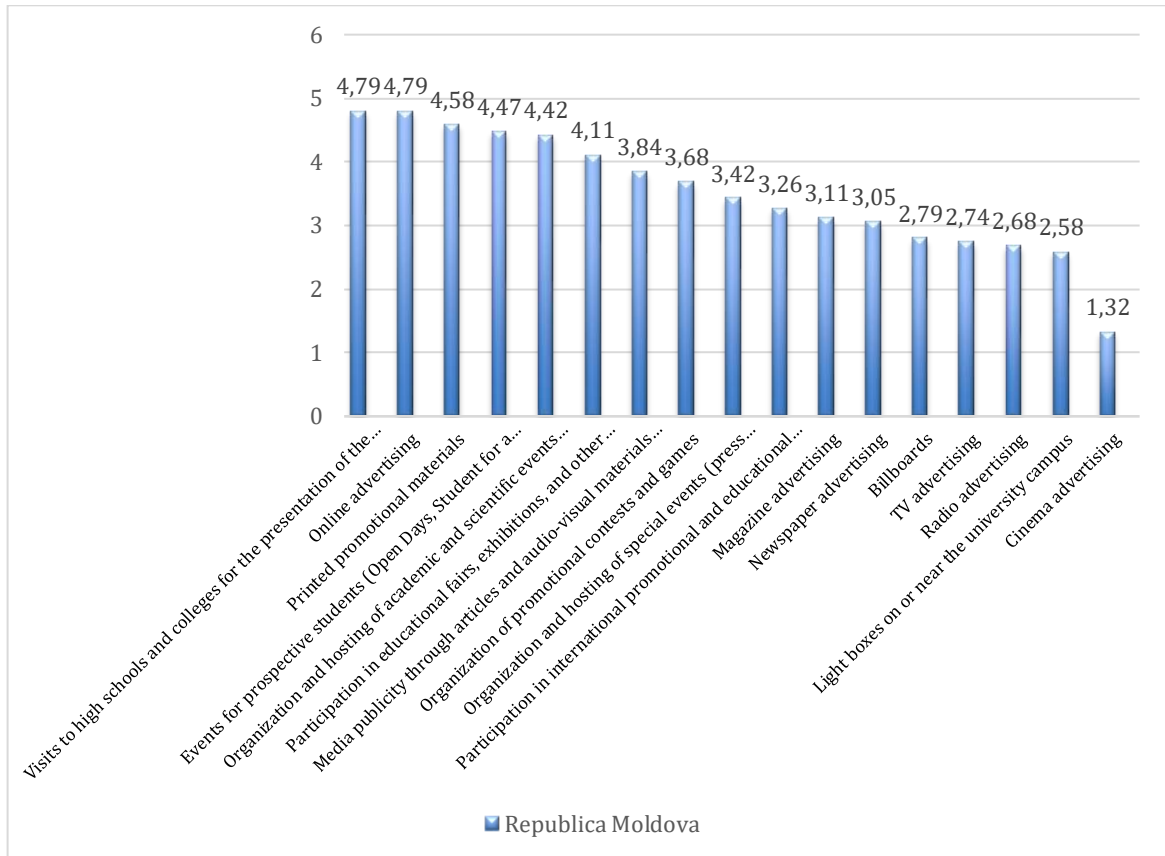


Figure 10. Tools and channels used by universities in the Republic of Moldova to promote their educational programs

Source: prepared by the authors based on the results of the research conducted

It is also worth noting that, in their marketing activities, universities are increasingly turning to a wide range of channels to promote their educational offerings and strengthen the university's image, with varying intensity depending on each institution's specific context. Thus, the most frequently used method proved to be visits to high schools and colleges, which allow for direct contact with potential applicants, scoring 4.79 on a 5-point scale ranging from 1 - least used - to 5 - most frequently used, followed by online advertising (online) - 4.79 (Fig. 10.. These are followed by printed materials (leaflets, brochures, posters, calendars, flyers) (4.58), a traditional channel still in use, and the organization of events dedicated to prospective students, such as "Open House" or "Be a Student for a Day" (4.47). Organizing and hosting academic events (congresses, conferences, seminars, forums) ranks at approximately the same level of importance (4.42), followed by participation in national fairs and exhibitions (4.11). In second place, but with consistent frequency, are the publication of articles and video/audio materials in the media (3.84), the organization of contests and promotional games (3.68), and the organization of special events (press conferences, official receptions) (3.42). The lowest values are observed for participation in international fairs and exhibitions (3.26), as well as for

traditional forms of advertising: in magazines (3.11), in newspapers (3.05), billboards (2.79), TV (2.74), radio (2.68), light boxes (2.58), and, obviously, movie theaters (1.32). This ranking shows that universities in the Republic of Moldova prioritize channels with a direct and immediate impact on the target audience - visits to high schools, events for prospective students, and online promotion - while traditional mass media advertising is used sporadically and plays a minor role in the current communication strategy.

5. Conclusions

Based on the literature review and the empirical research conducted, the following conclusions can be drawn regarding the role and implementation of marketing orientation in universities:

1. Marketing orientation is a key strategic imperative for improving the performance of for-profit organizations. At the same time, numerous studies in the fields of management and marketing have also highlighted the importance of developing a marketing orientation in nonprofit organizations, such as those in the arts and culture sector, the healthcare sector, the public services sector, etc., including higher education institutions.
2. A marketing orientation in university operations involves a combination of a focus on customers (students) and other stakeholders, a focus on competition, a focus on co-competitors, and a focus on cross-functional coordination within the institution.
3. Numerous studies have demonstrated that a marketing orientation must be adopted by universities in order to improve overall performance and gain a competitive advantage. Among the main benefits of a marketing orientation for universities are: a potential increase in enrollment rates and student retention rates, a positive impact on the research and teaching processes within universities, strong links to the quality of services perceived by students, student satisfaction and loyalty, word-of-mouth recommendations, perceived brand value, improved image and attractiveness of the university for prospective students, an effective means of developing the student-university relationship due to the university's greater ability to meet students' needs, and, above all, their ability to enter the labor market more effectively.
4. The research conducted has highlighted that universities in the Republic of Moldova have a strong awareness of the role of university marketing in strengthening the image and attractiveness of universities. At the same time, its practical implementation is in its early stages, requiring a strengthening of internal capacities to capitalize on the opportunities offered by modern marketing concepts, the diversification of marketing channels and tools used for institutional promotion and the promotion of study programs, with an emphasis on digital marketing tools, bringing about changes in attitudes within universities by adopting an appropriate marketing philosophy among all staff, and adopting marketing strategies and plans geared toward addressing institutional needs and achieving the proposed objectives.
5. Given the rapidly intensifying competition in the higher education services market at the global, regional, and local levels, universities must base their marketing policies on the presence of competition, their strengths and weaknesses relative to competing universities, and strategic and tactical decisions, the entire marketing toolkit, as well

as marketing programs and plans, must simultaneously be geared toward ensuring and developing competitive advantages and the overall competitiveness of the university.

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MODERN APPROACHES TO CIRCULAR INSURANCE

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Abstract: *The objective global need for the continuous development of the circular economy requires the promotion of essential elements of contribution, which are inclusively linked to the implementation of related insurance products united in a general notion of circular insurance. This involves applying circular economy principles to risk management and the insurance sector. This approach transitions from a linear model of "take-make-throw" or "pay-repair-replace" to one emphasizing repair, reuse, refurbishment, and waste reduction. The focus shifts from merely compensating for losses to actively preventing them and maintaining asset value. The research on the topic was based on examining information from open sources published on the Internet. The purpose of the paper was to present the conceptual aspects of circular insurance. Creating circular insurance requires transforming the sector from a traditional "take-make-dispose" approach to one that prioritizes resource efficiency, minimization of waste, and the ongoing utilization of materials. Essential strategies encompass promoting repair rather than replacement, providing products based on usage. These activities can be related to promoting new business models like sharing and Product-as-a-Service (PaaS), and facilitating the reuse of materials. Supporting the circular economy through insurance requires the development and implementation of new insurance products. In this context, leveraging technology and data becomes of great importance. At the same time, the development of circular insurance is linked to overcoming a wide range of challenges.*

Keywords: *circularity; insurance; product; technology; challenge*

Classification JEL: G22, Q56, G4

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1. Introduction

To transition from a "take-make-waste" linear model to a sustainable system that replenishes natural systems, lowers emissions, and separates economic growth from resource consumption, a circular economy must be developed. According to the Circularity Gap Report 2025 (CGR), the global economy is only 6.9% circular, a decline from 7.2% in 2023 and 9.1% in 2018. It means that over 90% of the more than 100 million tons of extraneous material produced each year are either recycled or not reused. (Reconomy).

This transition addresses environmental crises like climate change and pollution, while offering \$4,5 trillion in economic opportunities and fostering resilience, innovation, and job creation. (UNEP, 2021).

The following can be highlighted as the main factors and needs of the circular economy:

- The main argument is environmental protection, as the linear model causes significant pollution, waste and resource scarcity, threatening biodiversity and causing climate change.
- Second, resource scarcity and stability are manifested. As demand for resources increases, the circular model keeps materials in use through repair, reuse, and recycling, reducing dependence on imports and strengthening supply chains.

- The third argument is related to economic opportunity, stemming from the fact that moving to a circular model can create millions of jobs in sectors such as recycling, repair and remanufacturing.
- Fourthly, cost savings for private consumers and businesses driven by the creation of more durable products and the focus on repairs and renovations can be mentioned.
- Fifth, it is about the expectation of climate change mitigation, as waste reduction and material reuse contribute to significantly reducing greenhouse gas emissions.

Circular insurance, in the realm of the "circular economy," pertains to risk transfer solutions developed to enhance sustainability by emphasizing the repair, reuse, refurbishment, and recycling of materials instead of disposal.

Circular insurance involves implementing circular economy principles within the risk management and insurance sector, shifting from a linear "take-make-dispose" (or "pay-repair-replace") approach to one that emphasizes repair, reuse, refurbishment, and minimizing waste.

Circular insurance constitutes a revolutionary method that connects the insurance sector with the tenets of the circular economy - repair, reuse, and recycling - moving away from the conventional "take-make-dispose" paradigm. This model seeks to minimize waste, decrease carbon emissions, and prolong the lifespan of insured assets, especially in automobile and electronics insurance.

Circular insurance is frequently included in larger "sustainable," "ESG-focused," or "circular economy" insurance categories and represents a fast-growing sector that emphasizes underwriting risks associated with recycling, reuse, repair, and renewable technologies. The purpose of this article is to examine the basic aspects of circular insurance as a contributory element to the development of the circular economy.

2. Literature Review

The literature related to traffic insurance is relatively diverse, with the majority of bibliographic sources being the views of experts in the field. These sources can be conventionally divided into certain groups. Some authors examine the essence of circular insurance. (Neumann, 2025), (Meegle, 2026) Other experts have researched insurance as a factor supporting the circular economy. (Avantaventures, 2023), (Insurance), (Insurancetimes, 2024), (Neumann, 2025), (Steadfast, 2022) Works related to circular insurance products can be presented separately. (ABN AMRO, 2021), (Meegle, 2026), (Neumann, 2025), (Joey Galloway, 2023), (Steadfast, 2022) Likewise, research related to technologies used in circular insurance is worth mentioning. (Awasthy et al., 2025), (Revivack, 2024), (Alex Pezold, 2025), (V7Labs, 2025) Certain authors draw increased attention to the challenges for developing circular insurance. (Evolveable Consulting, 2024), (Hersch et al., 2024), (INGKA, 2023), (Kirchherr et al., 2018), (Mukhopadhyay, 2023), (Swiss Re, 2023).

3. Methodology

In order to carry out the research, the screening open information sources was applied as a research methodology is a systematic, transparent, and structured process of identifying, evaluating, and selecting relevant data from publicly available sources to answer specific research questions.

4. Results and Discussion

By switching from "replace-first" to "repair-first" models, cutting waste, and supporting new circular business models like sharing platforms and remanufacturing, circular insurance is essential to the circular economy. By controlling the risks associated with renewable energy, promoting repairs in claims, reducing emissions, generating new revenue sources, and enhancing resilience, it makes sustainability possible. (Neumann, 2025), (Meegle, 2026).

The role of insurance in supporting the circular economy can be expressed as follows (Avantaventures, 2023), (Insurance), (Insurancetimes, 2024), (Neumann, 2025), (Steadfast, 2022):

- *Sustainable Claims Management*: Insurers are updating policies to prioritize repair, refurbishment, and recycling over replacing items. This reduces carbon footprints in the claims process—often an insurer's largest environmental impact.
- *Enabling Circular Business Models*: Insurance supports the sharing economy (e.g., Uber, BlaBlaCar), product-as-a-service models, and repair businesses by identifying and mitigating new risks associated with these models.
- *Encouraging Resource Efficiency*: By promoting the repair and reuse of materials, insurers reduce reliance on virgin materials, aligning with the core circular goal of keeping products in use.
- *Risk Management for Green Technologies*: Insurers are increasing their portfolios to include renewable energy and green projects, with specialized underwriting for new risks, such as those in EV manufacturing.
- *Resilience Against Disruptions*: Circular practices (repairing rather than replacing) allow businesses to be less vulnerable to supply chain issues and volatile material costs.

Contributing to the development of the circular economy can have certain benefits for the insurance industry:

- *Reduced Costs*: Repairing instead of replacing can reduce the average cost of claims, improving long-term profitability.
- *Reputation Management*: Engaging in circularity helps carriers meet consumer demand for sustainability and enhances their reputation, protecting them from criticisms related to insuring high-carbon industries.
- *Innovation and New Markets*: The transition allows insurers to develop new insurance products designed for circular supply chains.

- *Customer Loyalty*: Circular insurance boosts customer loyalty by integrating sustainability (repair, reuse, recycling) into claims and service, aligning with eco-conscious consumer values to build trust.
- *Regulatory Compliance*: It meets emerging EU requirements, such as the Circular Economy Action Plan, which prioritizes resource efficiency.

An important aspect of developing circular insurance is innovating product offerings:

- ***Product-as-a-Service (PaaS) Coverage***: Product as a Service (PaaS), also known as a Product-Service System (PSS), is a business model within the circular economy that prioritizes selling a service or functional capability of a product instead of the product itself. In numerous PaaS frameworks, companies maintain ownership of the physical asset and rent it out to clients who pay a subscription fee based on time or usage. (Robeco) Circular insurance for Product-as-a-Service (PaaS) models shifts risk from ownership to usage, protecting providers rather than consumers. Policies often cover maintenance and repairs, incentivizing high-quality, durable products. Insurance protects the provider who retains ownership of the asset, covering potential damage or loss during the customer's usage. It covers maintenance, repair, and refurbishment costs to extend product life, ensuring sustainability. Insurance ensures that after the subscription, the product can be safely returned, refurbished, or repurposed rather than discarded. This model requires insurance that covers asset return, re-manufacturing, and performance-based liability, covering the entire lifecycle rather than a single sale (ABN AMRO, 2021).
- ***Repair and Reuse Focus in Claims***: Redesigning policies to incentivize repairing insured assets (e.g., vehicles, electronics) instead of automatic replacement, reducing waste and lowering claims costs.
- ***Sustainability-Linked Policies***: Policies are increasingly designed to prioritize repairing insured assets (e.g., vehicles, building materials) over replacing them with new ones, which significantly lowers carbon emissions and waste. Offering premium discounts or coverage benefits for policyholders adopting eco-friendly behaviors or utilizing refurbished components. Policyholders may receive lower premiums or better coverage terms for opting to use certified repair networks or recycled parts. (Meegle, 2026), (Neumann, 2025)
- ***Usage-Based Insurance (UBI)***: UBI often referred to as telematics or pay-as-you-drive (PAYD) insurance, is a modern auto insurance model that determines premiums based on actual vehicle usage—including distance, driving behavior, and time of day—rather than traditional static factors like age, gender, or credit history. By leveraging technology such as telematics devices, Bluetooth beacons, or mobile apps, UBI offers a more personalized and transparent pricing structure that can reward safe and low-mileage drivers with lower premiums. Use IoT devices to calculate premiums based on actual usage, encouraging shared ownership models like car-sharing. (Indusindinsurance)
- ***Warranty for Refurbished Goods***: Refurbished goods are increasingly supported by robust warranty and insurance structures, often designed to facilitate the circular economy by extending product lifecycles and encouraging repair over disposal. These guarantees are distinct from new product warranties, typically featuring shorter durations or specific coverage tailored to certified reconditioning standards.

- **Take-back Scheme Insurance:** Protects manufacturers or retailers that take back products for recycling or refurbishment, covering risks associated with the return logistics and secondary material value. Take-back schemes are a core component of the circular economy where manufacturers or retailers take back products at the end of their first life cycle to refurbish or recycle them. These schemes introduce new risks, such as liability during transport, storage, and refurbishment, which require specialized insurance coverage. (Joey Galloway, 2023), (Steadfast, 2022)
- **Shared Asset Coverage:** Developing specialized insurance for collaborative consumption models, such as car-sharing or peer-to-peer platforms. Shared asset coverage within a circular insurance context typically refers to insurance models supporting the circular economy, where assets (like vehicles, tools, or machinery) are shared, rented, or reused rather than owned individually. These policies often use microinsurance to cover risks for the duration of a transaction, such as a rental or delivery period.

Offering circular insurance products requires leveraging technology and data. First of all, it's about **IoT & Telematics**.

Real-time monitoring of assets to enable preventive maintenance and increase lifespan. Use sensors to monitor assets in real-time, enabling preventive maintenance that extends their lifespan and reduces claims. IoT and telematics are rapidly transforming the insurance industry, shifting it from a reactive "repair and replace" model to a proactive, "predict and prevent" approach. This evolution is key to circular insurance, which aims to reduce waste, extend the life of assets, and promote sustainability through real-time risk management. (One Inc, 2022), (One Inc, 2024), (Sharma, 2025)

Key Applications of IoT & Telematics in Circular Insurance (Com4, 2025), (Koppanati, 2024), (One Inc, 2022), (One Inc, 2024), (Sharma, 2025):

- **Usage-Based Insurance (UBI):** Telematics devices and smartphone apps collect real-time data on driving behavior (braking, speed, mileage) to personalize premiums, rewarding safe, low-mileage drivers.
- **Predictive Asset Maintenance:** Sensors on commercial equipment and vehicles monitor health in real time, detecting issues before they fail. This prevents major claims and extends the lifespan of the machinery.
- **Property Protection & "Connect and Protect":** IoT sensors detect water leaks, smoke, or electrical hazards, triggering immediate alerts to prevent damage. For instance, smart plugs monitor electrical wiring for potential fire hazards, allowing for intervention before a fire occurs.
- **Claims Management & Fraud Reduction:** IoT data provides objective evidence of incidents (e.g., speed at time of impact), accelerating claims settlement and reducing fraud.
- **Environmental Monitoring:** Sensors in agriculture or logistics track conditions like temperature and humidity, mitigating risks for cargo and reducing waste.

Secondly, **Blockchain for traceability** is worth mentioning. It refers to using decentralized, immutable digital ledgers to track the entire lifecycle of a product or asset - from production and use through repair, reuse, and recycling - to enable more accurate risk assessment, automated claims processing, and sustainable underwriting in a circular economy. By ensuring that data regarding the origin, ownership, and condition of a product is authentic

and tamper-proof, blockchain allows insurers to move from traditional linear (take-make-dispose) insurance to a circular, data-driven model. (Awasthy et al., 2025), (Revivack, 2024).

Thirdly, *AI for claims optimization* in circular insurance requires examination, which refers to using artificial intelligence - specifically predictive analytics, computer vision, and generative AI - to accelerate, automate, and make more precise the process of assessing, repairing, and settling claims within a circular economy framework. Unlike traditional "linear" insurance (take-make-waste), circular insurance focuses on repairing, reusing, and recycling assets. AI optimizes this by enabling faster claims handling, reduced manual tasks, and improved customer experience, while fostering sustainability by favoring repair over replacement. (Alex Pezold, 2025), (V7Labs, 2025).

The development of circular insurance faces a number of challenges (Evolveable Consulting, 2024), (Hersch et al., 2024), (INGKA, 2023), (Kirchherr et al., 2018), (Mukhopadhyay, 2023), (Swiss Re, 2023):

- *Limited Data and Risk Assessment:* Effective circular insurance requires high-quality, reliable data to assess risk. The lack of standardized data for refurbished items creates uncertainty in pricing and underwriting. Circular economy models, such as remanufacturing, renting, or repairing, lack extensive historical data. Insurers struggle to quantify the risks of novel technologies and materials, making it difficult to underwrite them. This "data gap" makes it difficult to predict failure rates, product lifespans, and, consequently, to price premiums accurately.
- *Increased Fire and Property Risks:* During the period 2025-2026, there is a sharp increase in the risks of fire and property damage, driven by climate change, urban expansion and increased levels of industrial hazards. Recycling facilities, which are crucial to circularity, often involve high combustibility and unpredictability. Past large-loss fire incidents have resulted in limited insurance capacity, higher premiums, and reduced insurability for these entities.
- *Regulatory Hurdles and Uncertainty:* Existing insurance regulations are designed for traditional products and often do not accommodate the unique characteristics of circular economy contracts, such as pay-per-use or sharing schemes, leading to compliance hurdles. Circular business models often involve remanufactured, repaired, or shared products. Insurers face uncertainty in determining liability if a refurbished product fails, as the original manufacturer might not be the entity repairing or selling it. Insurance regulations are often fragmented by region or sector, particularly in hybrid products (e.g., travel insurance), creating uncertainty about which rules apply. This restricts the introduction of modular or flexible coverage, which is essential for circular products.
- *Lack of Standardization:* There is an absence of global standards for recycling operations and circular products. Industry classifications are inconsistent, preventing insurers from applying standardized risk management practices.
- *Complex Supply Chains:* Circularity requires close coordination between multiple stakeholders (manufacturers, repair shops, recyclers, users), which complicates risk management and insurance logistics. Setting up logistics for collecting used items, testing their safety, and reconditioning them requires significant financial outlay and partnership development. In complex, interconnected supply chains, this means

insuring against risks associated with reverse logistics, the quality of recycled materials, and the reliability of partners in a closed-loop system.

- *High Initial Costs:* While circular insurance promises long-term savings and risk reduction, the initial transition phase often faces prohibitive expenses. Implementing circular models often requires high upfront investment in new technologies, training, and operational restructuring, which can be prohibitive. Insurers must invest heavily in new technology, including IoT (Internet of Things) devices for monitoring assets and data analytics systems to track product lifecycles, enabling repair or reuse rather than replacement. Implementing circular models requires substantial resources for developing new workflows, retraining staff, and restructuring claims management systems to prioritize repair and refurbishing over cash settlements. Insurers often require in-depth, regular property assessments of recycling and refurbishment facilities, driving up the cost of underwriting risks for circular businesses. In some cases, the initial insurance fees for companies applying circularity can be higher due to the unknown risk profiles of new, innovative materials or processes.
- *Socio-Cultural Barriers:* These barriers stem from established consumer mindsets, hesitancy within companies to change traditional business models, and a general lack of awareness regarding the benefits of a circular economy. A strong "ownership" culture in many regions creates resistance to renting or sharing models, limiting the demand for products supported by circular insurance.

Conclusions

Circular insurance in the context of the circular economy represents an innovative approach to the insurance sector, adapted to support the transition from the linear economic model ("produce-use-dispose") to a circular one, which prioritizes the reduction, reuse, repair and recycling of resources. Unlike traditional insurance that often replaces damaged products (leading to waste), circular insurance encourages the repair, refurbishment and extension of product lifespans. Circular insurance is not just a simple financial product, but an essential tool for reducing risks in the green transition, focusing on long-term value and sustainability. It covers emerging risks related to recycled materials, new recycling technologies and green production processes and focuses on a better understanding of the risks associated with secondary raw materials (recycled materials) and their reliability in production.

Circular insurance products, in the context of the circular economy, are innovative financial instruments designed to support business models that prioritize waste reduction, resource reuse, repair and recycling. These include insurance for PaaS models, repairability and refurbishment insurance, insurance for circular supply chains, liability insurance for waste management, insurance for emerging risks. The main challenges identified include the lack of historical data and risk uncertainty, the complexity of damage assessment, environmental and legal liability, high initial costs, regulatory and technical obstacles.

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LINGUISTIC CAPITAL AS A KEY FACTOR OF SOCIAL INCLUSION AND COMMUNITY RESILIENCE IN THE GLOBALISED CONTEXT

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Abstract: *With regard to the general trends associated with globalization and other aspects of contemporary society, linguistic capital has come to play an increasingly important role in ensuring social integration and improving the resilience of communities. Following the ideas put forth by Pierre Bourdieu, it is possible to regard linguistic capital as an element of cultural capital and one that exerts considerable influence on people's access to education, work, and social life. This paper aims at investigating the part played by linguistic skills in helping people integrate into society and improve their ability to respond to changes generated by globalization. To achieve the stated purpose, the study draws upon insights offered by linguistics, sociology, and socio-economic science in order to analyse the connection between linguistic diversity, occupational mobility, and sustainable social development. According to the empirical evidence provided by the analysis of questionnaires, multilingualism appears to have a positive impact on the job-related success of respondents, including their chances of finding employment and earning more money. At the same time, it should be noted that differences in access to language training programs may help maintain existing social disparities. Overall, linguistic and intercultural skills contribute both to economic success and effective intercultural communication and social integration. Therefore, promoting language education and recognizing linguistic diversity may become powerful tools for increasing social inclusiveness and improving the resilience of societies to global problems.*

Keywords: *linguistic capital, multilingualism, social inclusion, employability, academic mobility, community resilience, globalisation, intercultural competence, linguistic diversity.*

Classification JEL: I25, J24, Z13.

UDC: 81'27:316.42.063.3

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1. Introduction

Within the context of accelerating globalization, economic activity, labour markets, and social interaction are increasingly shaped by intercultural communication and cross-border exchange. However, widely known factors of social economic outcomes such as education, skills, and work experience remain important, growing attention is being paid to the role of language as a strategic resource. In this regard linguistic capital become a key factor that influence individuals access to academic and professional opportunities, and the capacity of communities to adapt to complex and dynamic environments. Regardless of the expanding relevance of language in globalised societies, its role is often underexplored in socio-economic analysis. Currently, research tends to examine human capital primarily in terms of formal education and technical skills, while the contribution of language skills to employment, income, and social integration remains insufficiently integrated into mainstream conceptual frameworks. In a context characterized by high mobility, cultural diversity, and increasing demands on intercultural communication, this gap is particularly important.

Within this framework, the present study examines linguistic capital as a factor of social inclusion and community resilience and aims to analyse how language competences

influence individuals' integration into the labour market and their ability to access economic opportunities, as well as how they contribute to the adaptive capacity of communities in a globalised environment. With reference to the theoretical framework and empirical data from previous studies, the present paper tests the following hypotheses: (1) Higher levels of linguistic competences correlate with greater employment prospects and higher earnings. (2) Linguistic capital has a positive impact on community resilience by promoting adaptive capacity, cooperation and social cohesion in the context of globalization. (3) Multilingualism is positively associated with stronger social inclusion, greater academic mobility, and improved labour market integration.

In terms of methodology, the paper uses an interdisciplinary approach, combining theoretical concepts from sociolinguistics and economic sociology with empirical evidence derived from survey data. This allows for a comprehensive analysis of linguistic capital as both – an individual and a systemic resource. The originality of the study lies in the integration of linguistic, economic and social approaches to understanding linguistic capital not only as a means of communication, but also as a strategic resource influencing inclusion and sustainable development. By analysing micro-level outcomes such as employment and income in correlation with macro-level effects, including social cohesion and community adaptability, the study deepens our understanding of the role of language in the functioning of modern societies.

The present article is structured as follows: the next section presents the theoretical framework and literature review, followed by a description of the methodology. The Results and Discussion section discusses the results in the context of existing theories and proposed hypotheses, and the final section presents conclusions, implications, and directions for future research.

2. Literature Review

The concept of linguistic capital that originates in the sociological theory of capital was developed by a prominent French sociologist and anthropologist Pierre Bourdieu in 1991. The researcher distinguishes between economic, social, and cultural capital as key determinants of individuals' position within the social structure, considering language to be a form of symbolic and cultural capital. Within this framework, language competencies represent socially valuable resources that influence individuals' access to education, academic mobilities, employment, and participation in institutional life. In this regard, the value of linguistic capital depends on its recognition within a given social field, reflecting broader mechanisms of societal inclusion and exclusion.

Building on Bourdieu' foundation, within the current research, the comprehension of linguistic capital has been expanded beyond its symbolic dimension, highlighting its practical and economic significance in a globalized world. International academic and professional mobility, migration, and the expansion of global markets have intensified intercultural interaction and the necessity for multilingual communication. According to Hirbu and Dombrovski (2025), the globalization has transformed the circulation of linguistic resources, correlating language competencies more closely with social and professional mobility, and economic outcomes. Therefore, linguistic capital can be defined as a strategic resource that facilitates the integration of individuals into the transnational economic and social space.

In contemporary sociolinguistics, the functions of language aimed at identity and supporting social initiative and community solidarity are gradually expanding. As Deardorff (2006) and Heller (2007) note, the use of languages is a reserve part of the process of active interaction and influence on interaction in social settings. Language skills become standards for building a cohesive society in a multilingual environment, as they ensure dialogue between different communities. Given linguistic capital, the growth of community resilience in the context of globalization, characterized by uncertainty and dynamic change, is of great importance. The importance of multilingualism and intercultural dialogue as control components of the identity principle is again demonstrated by recent studies by Hirbu (2024; 2025), as they play a decisive role in the coexistence of social cohesion and leadership within Europe and beyond. Thus, the coexistence of different languages can be understood not only as a cultural diversity but also as a factor contributing to social cohesion and economic sustainability.

Despite the existence of many studies on the subject, the inclusion of language assets into mainstream socio-economic analysis is still not widely explored. Previous works have mostly focused on studying either economic or cultural dimensions separately, without recognizing the fact that language as a strategic asset has an interdisciplinary nature.

In response to this limitation and to synthesize all perspectives, this study proposes an expanded conceptualization of linguistic capital emphasizing its multidimensional nature. Within this study, it is considered as a multidimensional construct composed of knowledge, competencies, value and economic dimensions. As a complex and dynamic set of linguistic, discourse, communicative, and pragmatic competencies and knowledge, coupled with intercultural competence, linguistic capital functions as a strategic resource for economic development, career advancement, and social integration. By integrating these dimensions, it operates simultaneously at the both – individual and systemic levels. Thus, linguistic capital is understood not only as a personal resource but also as a structural mechanism linking micro-level opportunities to macro-level processes of integration and sustainability in globalized societies.

3. Methodology

The research design employed in this study is a mixed-method approach where quantitative and qualitative methodologies are used to examine how language capital contributes to social inclusion and labor market opportunities in a globalized environment. This research design highlights the importance of capturing objective trends and subjective experiences regarding the use of language in the economic sphere.

Objectively speaking, data was obtained using a survey from 134 subjects through a questionnaire that included close-ended questions as well as open-ended questions to allow the subjects to explain their experience. The questionnaire helped capture the information related to four major dimensions including (1) sociodemographic characteristics such as education and workplace, (2) language capital including number of languages spoken, frequency of language use, and self-perceived level of language ability in non-native languages, (3) labour market effects on employment, promotion, and earning potential, and (4) institutional effects through language training by employers.

The quantitative data was subjected to descriptive statistical analysis (frequencies and distribution), while qualitative data was analysed using the thematic method, which

identified recurring themes regarding the perceived usefulness of linguistic capital. The application of such an analysis considering both quantifiable measures and perceptions demonstrates the multi-faceted nature of linguistic capital and its significance to social integration and sustainable communities.

4. Results and Discussion

The analysis starts with a description of the sociodemographic characteristics of the participants, providing a necessary background for interpreting the results. According to our data, the sample reflects a heterogeneous group, a significant portion of which has working experience in an international environment.

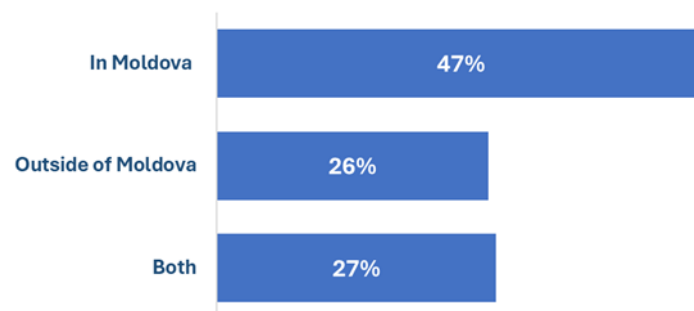


Figure 1. Distribution of respondents by employment location

Source: Author's elaboration based on survey data

Regarding the information on employment location, as shown in Figure 1, 47.0% of respondents are professionally active in the Republic of Moldova, while 26% work in an international environment, and 27% report hybrid forms of working arrangements. This distribution indicates that more than half of the respondents are fully or partially involved in international professional activities, which is particularly significant for assessing the role of linguistic capital in the globalized labour market.

Before examining the impact of linguistic capital on careers, a brief overview of the respondents' professional profiles is in order, as shown in Figure 2. The sample is dominated by respondents from the education and science sectors (34.6%), followed by representatives of business and finance (19.4%) and the IT and technology sectors (13.4%).

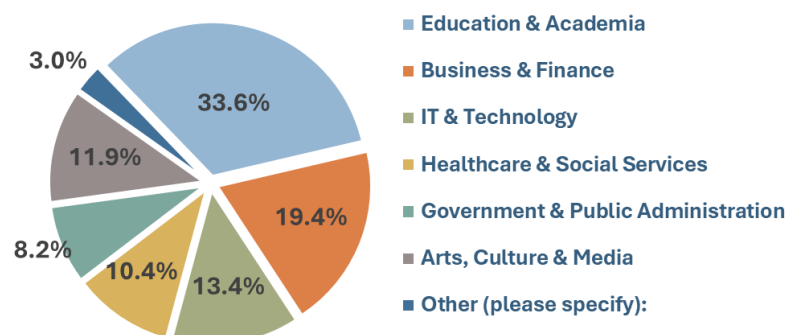


Figure 2. Distribution of respondents by professional field

Source: Author's elaboration based on survey data

Others were represented in the arts, culture, and media (11.9%), healthcare and social services (10.4%), public administration (8.2%), and other areas (3.0%). The preponderance of education and service-related sectors may point to the relevance of linguistic capital in professional fields where communication skills are important.

Speaking about the level of education, it should be mentioned that all categories are well-represented, as seen from Figure 3 below. Those respondents who obtained only a high school diploma account for 30.6%. Those with a master's degree represent 26.9% of respondents, while a bachelor's degree is acquired by 21.6% of respondents. A considerable number of people (20.9%) have a doctorate.

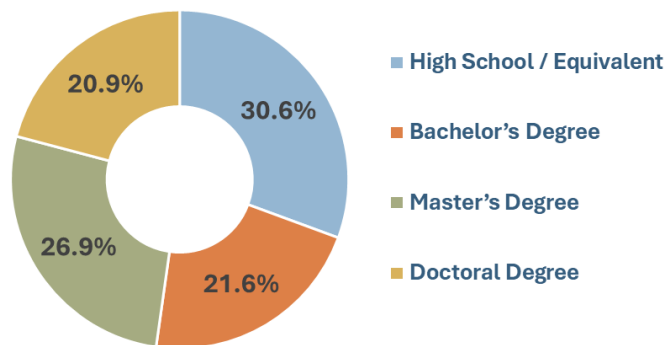


Figure 3. Distribution of respondents by educational attainment

Source: Author's elaboration based on survey data

The collected data help ensure the validity of the study by allowing researchers to examine the effects of language capital across different levels of human capital. In general, the sociodemographic characteristics of the respondents provide a suitable starting point to explore the impact of language capital on employment, earnings, and social integration within different environments around the world.

Having analysed the sociodemographic data, the discussion is now shifting to the linguistic capital characteristics of the respondents, which serve as the key independent variable in the study. The sample appears to have a high degree of multilingualism in terms of the data gathered. A significant number of respondents are familiar with at least two foreign languages, while some can speak three or more languages. This demonstrates that the respondents have a solid linguistic background, considering their relative exposure to international situations shown in Figure 1.

More than anything else, the frequency of language use is important because it provides necessary information about the way linguistic capital is utilized. Over 50% of the respondents claimed to use foreign languages very frequently or even constantly when performing their professional duties. This means that, in this group of people, language skills are viewed not only as knowledge but also as tools. Therefore, in such a way, it can be assumed that linguistic capital is quite developed and relevant for practical purposes, proving the hypothesis that language skills provide opportunities to participate in the globalized job market. In addition, the results of this study prove that linguistic capital is a practical and strategic advantage that should be considered in addition to being a simple attribute of education or formality.

As far as the evaluation of the benefits of linguistic capital and international experience for career growth is concerned, the results show that respondents find these factors to be positive, although their significance and influence differ among various indicators (see Figure 4).

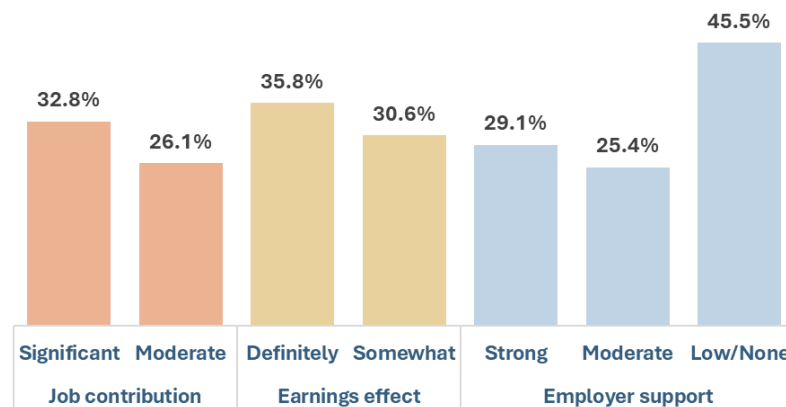


Figure 4. Impact of Linguistic Capital on Career Outcomes

Source: Author's elaboration based on survey data

In regards to the employment implications as well as work performance, 32.8% of respondents stated that the contribution of their language and intercultural skills towards their employment was significant, whereas 26.1% said it was moderate. This means that these skills make a considerable contribution to employment or performance of professional tasks for a large number of respondents. The obtained results prove the hypothesis according to which language capital functions as an important factor that makes individuals employable.

Similarly, the positive effects were seen when considering respondents' opinions about the implications of their language capital on their incomes. Almost one-third of respondents, 35.8%, claimed that they had a positive effect on their income, whereas another 30.6% thought that there was some kind of effect in this area. As we can see, respondents are not only aware of the fact that their language and intercultural skills improve their employment chances, but they also perceive these skills as those that help them earn more money. In other words, language capital may be viewed as human capital.

Regarding corresponding responses to questions concerning employer encouragement, a more nuanced picture of institutions emerges. In particular, 29.1% of respondents identified their employers as supportive, 25.4% mentioned employer support in various degrees, whereas the biggest share – 45.5% – stated that their employers did not encourage them much or at all. Thus, one can conclude that there is another interesting ambiguity here: despite evident individual benefits from linguistic capital, organizational recognition and institutional support are quite inconsistent. The fact that the effects of linguistic capital on professional performance and salary are relatively high yet a significant number of people perceive it as inadequate indicates that its professional value becomes tangible due to individual efforts but not because of long-term employer engagement. Such findings can form a solid foundation for more profound research into the interdependence of linguistic capital, employment, and social integration, which will be conducted in subsequent studies.

Lastly, there was an attempt to interpret the responses to the last open-ended question, which read: "In your opinion, how do language proficiency and multilingualism promote social

inclusion and social resilience of communities under the conditions of globalization?" It appears that language proficiency contributes to both individual integration into society via education, employment, career progress, and higher salaries. At the same time, multilingualism is seen by the respondents as a tool for fostering communication and cooperation between social groups. All of these considerations allow us to speak about language capital as both a resource for individual success and a driving force of social integration.

5. Conclusions

The current research clearly demonstrates that linguistic capital is an important factor that determines the degree of social inclusion and resilience in the globalization age. According to the findings, language skills play an important role in providing people with better job opportunities and greater earnings, while helping to obtain access to education and effective social interaction. At the same time, linguistic capital performs certain social functions by helping develop social ties between different cultures via dialogue and cooperation. In other words, the phenomenon under investigation proves to be beneficial for the society rather than the individuals.

Despite that, the research shows that there is a lack of state policy to encourage language development. Consequently, all advantages that result from linguistic capital may fail to be fully implemented, thus aggravating social inequity. Overall, the paper highlights the importance of language learning for creating an environment of inclusion and resilience in modern society.

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MICRO-CREDENTIALS AS AN INSTITUTIONAL RESPONSE TO LABOUR MARKET TRANSFORMATION: UNIVERSITIES AND THE SHIFT TOWARD FLEXIBLE LEARNING

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Abstract: Skills are losing economic value faster than the multi-year university degree can renew them. Employers expect 39% of core skills to change by 2030, and the pressure is heaviest in economies that cannot replenish their workforce demographically. Both the European Union and, more recently, the Republic of Moldova have promoted micro-credentials as the institutional response to this pressure. Whether universities can actually function in that role, however, depends on conditions that the literature has not yet examined in detail, particularly for a small EU-candidate economy. The present paper builds a conceptual framework that combines human-capital theory, signalling theory and institutional isomorphism, and applies it through a comparative documentary analysis of European policy instruments, the legislation of Ireland and Estonia, and the Moldovan legal architecture. We argue that micro-credentials act on human capital through three functions (replacement, unbundling and augmentation), and that each of them depends on the same enabling condition: a trusted institutional guarantor, dedicated public funding for the start-up phase, and full integration into the qualifications framework. Ireland and Estonia satisfied this condition by different legal routes and their universities reached scale. Moldova has built an equivalent legal framework but channels provision through adult education without placing universities at the centre, and take-up has remained low. The binding constraint is institutional rather than legal, and the paper draws concrete policy implications from this finding for the Moldovan higher-education system.

Keywords: micro-credentials; institutional agility; human capital; signalling; higher education; Republic of Moldova; European Qualifications Framework.

JEL Classification: I23, J24, I28.

UDC: [378.14+374.7]:331.5

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1. Introduction

Employers surveyed across 55 economies expect 39% of workers' core skills to change by 2030, and 63% of them now identify skills gaps as the single largest barrier to transforming their businesses (World Economic Forum [WEF], 2025). The multi-year university degree, the institution that has historically certified competence in modern economies, renews skills on a cycle measured in years, whereas the skills themselves are increasingly turning over within a five-year horizon. As the same report observes, labour markets are evolving faster than education and training systems can adapt (WEF, 2025). The gap between the rate at which skills lose value and the rate at which the dominant qualification can renew them is the starting point of this paper.

That gap is sharpest where an economy cannot replenish its workforce demographically. The Republic of Moldova is such a case. Nearly 30% of its people now live abroad, its working-age population has been shrinking since 2008, and the country's overall population could be nearly one-third smaller by 2050; emigration is depleting the working-age population both in the national labour market and in the countryside, and skills mismatches persist (European Training Foundation [ETF], 2025). An economy losing labour at this rate cannot wait for new cohorts of graduates to refresh its skill base. It must reactivate the competences of the

workers it still has, which is the task for which short, flexible, modular provision is designed. In the Moldovan context, the abstract policy debate over micro-credentials thus acquires a concrete and pressing economic stake.

Micro-credentials have been promoted as the institutional answer to this pressure. The European Union adopted a common approach in its 2022 Council Recommendation on micro-credentials for lifelong learning and employability (Council of the European Union, 2022), and Moldova has since embedded micro-credentials, under the local term of partial qualifications, in its own legal framework, through the National Qualifications Framework and the methodology governing adult education (Buimestru et al., 2025). Putting an instrument into law, however, is not yet the same as putting it to use. Whether universities are able to take on the role of the institution that genuinely responds, or whether micro-credentials end up as a peripheral catalogue of courses (or, worse, as a force that fragments the degree from which they are drawn), remains an open question. The conditions under which a micro-credential genuinely becomes an institutional response to labour-market change have not been examined in detail in the literature, and the gap in the literature is particularly wide for a small candidate economy aligning its system with the EU.

This paper examines those conditions. It asks under what circumstances micro-credentials function as a genuine institutional response by universities to labour-market transformation, and what the European policy framework implies for their adoption in Moldova as an EU-candidate state. Two subsidiary questions follow: how the transformation of the labour market defines the response expected of universities, and why the institutional environment – funding, quality assurance, and integration into the qualifications framework – governs whether that response can be realised.

The argument is theoretical and comparative. The conceptual framework combines human-capital theory (Becker, 1964), signalling theory (Spence, 1973) and institutional isomorphism (DiMaggio & Powell, 1983), and is applied through a structured documentary analysis of European policy instruments, the legislation of two front-runner systems (Ireland and Estonia), and the Moldovan legal architecture. The reasoning is interpretive: the paper aims to identify the institutional conditions under which the response can succeed, rather than to estimate a statistical relationship between variables. Its contribution is to bring out a condition that the current debate has left implicit. Three functions through which micro-credentials act on a worker's human capital are distinguished – replacement, unbundling and augmentation – and we argue that each of them requires the same institutional support: a trusted guarantor of the credential, public funding for the early phase, and integration into the qualifications framework. Reading the Moldovan case against the systems that have satisfied this requirement makes it possible to locate the country's specific constraint.

2. Literature Review

2.1. The economic rationale and its unresolved core

The point of departure of the literature is an economic one. The recent expansion of micro-credentials is commonly traced to two simultaneous pressures: a rising demand for upskilling and reskilling, as skills become obsolete faster, and a sharp fall in the unit cost of provision made possible by digitalisation (Kato, Galán-Muros, & Weko, 2020). This places the phenomenon within human-capital theory (Becker, 1964), where education is treated as an

investment in a depreciating stock of productive capacity, and within signalling theory (Spence, 1973), where the value of a credential lies in the information it transmits to employers. The OECD synthesis captures both functions, describing alternative credentials as instruments that help learners acquire new skills, update existing ones and signal competences they already hold (Kato et al., 2020). What the literature has not yet settled is whether short credentials genuinely build durable human capital or whether they perform mainly a signalling role. The empirical evidence on returns is still thin, and the same OECD work acknowledges that, despite rapid growth, considerable uncertainty remains about how learners, employers and governments actually value these credentials. As things stand, the economic case for micro-credentials rests more on the strength of the assertion than on the available evidence.

2.2. Definition, standardisation and the recognition problem

A second strand of the literature concerns what a micro-credential actually is. Reviews repeatedly note a proliferation of competing definitions, which converge only on the minimal idea that the volume of learning is small and that delivery is comparatively flexible (OECD, 2021). The European response has been to construct a common reference: the Council Recommendation of June 2022 fixes a definition and a set of common descriptive elements, and recommends that member states build a micro-credential ecosystem supported by the existing recognition infrastructure of the European Qualifications Framework, Europass and ESCO (Council of the European Union, 2022). Comparative policy work has found that providers themselves prefer to operate under nationally agreed recognition frameworks rather than in isolation (OECD, 2023), which suggests that standardisation should be understood as a precondition for use rather than as a bureaucratic afterthought. Recognition and portability across providers and borders are, even so, only partially resolved, and the literature treats trust as something to be engineered rather than as a given. The literature has therefore identified the problem with reasonable clarity, but it has rarely asked which institution should bear the responsibility of resolving it.

2.3. Genuine transformation or the unbundling of the degree?

The most consequential debate in the literature is institutional, and it is sharply polarised. An early and broadly optimistic strand framed micro-credentials and digital badges as an opportunity to widen access, recognise discrete achievement and make higher education more responsive (Gibson et al., 2015; Oliver, 2019). Against this stands a forceful critique. Wheelahan and Moodie (2021) argue that micro-credentials extend the way in which human-capital theory disciplines the higher-education curriculum, and that they rest on a behaviourist, competency-based logic in which qualifications are disaggregated into components and then reassembled as though the parts summed to the whole. On this account, the model shifts the cost of training onto the individual learner and requires the learner to second-guess employer requirements; a wrong guess becomes a bad investment. The fragmentation of learning into small units, in addition, threatens the sequenced and cumulative knowledge that degrees are designed to build (Wheelahan & Moodie, 2022). The disagreement runs along a clear fault line: the same modularity that proponents read as flexibility, critics read as the unbundling of the degree and the erosion of its coherence. Neither side, however, has specified the institutional arrangements that would separate the two outcomes, that is, the conditions under which modular provision strengthens, rather than dismantles, the qualification from which the modules are drawn.

2.4. Why institutions adopt, and the role of the state

A fourth strand of the literature explains adoption rather than evaluating it. The near-simultaneous appearance of broadly similar designs across very different systems is consistent with the theory of institutional isomorphism (DiMaggio & Powell, 1983): coercive pressure from supranational recommendations, normative pressure through shared quality standards, and mimetic imitation of early movers under conditions of uncertainty. Policy analysis adds the state as an active agent, documenting the public-funding instruments used to seed provision, from individual learning accounts to dedicated short-course trials in higher education (OECD, 2023). This work is informative about the mechanics of diffusion, but it tends to stop at the moment of adoption. It documents that institutions take micro-credentials up and which policy instruments accompany the process, without examining when adoption translates into an effective response to labour-market change and when it remains a symbolic or revenue-driven addition.

2.5. An evidence base skewed toward advanced systems

Finally, the empirical literature is geographically uneven. The richest evidence comes from advanced systems – Ireland, Australia, and OECD case studies of member states such as Finland, Slovenia, Spain and the Slovak Republic (OECD, 2023). Studies of small, transition, or EU-candidate economies are scarce, even though it is precisely there that the labour-market pressure is most acute and institutional capacity thinnest. For Moldova, the principal national reference is a practitioner implementation guide produced with international support (Buimestru et al., 2025) rather than analytical research, leaving the country's experience largely outside the scholarly conversation.

2.6. The gap this paper addresses

Taken together, these strands of the literature leave a specific opening. The economic rationale has been laid out, but its signalling condition (the question of who guarantees the credential) has been under-theorised. The central debate between transformation and unbundling has been conducted in the abstract, or within advanced systems, without specifying the institutional condition that determines which of the two outcomes occurs. The diffusion literature explains adoption but not effectiveness. The empirical base, finally, passes over the small EU-candidate economies where the stakes are highest. The present paper addresses this opening on two fronts. At the conceptual level, it links the three functions of micro-credentials in human-capital terms (replacement, unbundling and augmentation) to a single enabling institutional condition, and so brings out the guarantor-funding-framework nexus that the existing debate has left implicit. At the empirical level, the framework is applied to the Moldovan case within its European context, where the distance between an acute need for flexible reskilling and the institutional agility of universities is, as the following analysis shows, at its widest.

3. Methodology

The study is theoretical and qualitative. Its unit of analysis is the university as an institutional actor, and its object is the set of conditions under which micro-credentials function as an institutional response by universities to the transformation of the labour market, in the form of a shift toward flexible and modular learning. The study does not test a hypothesis against a dataset. It develops and applies a conceptual framework to a

policy phenomenon that is still acquiring its institutional shape, reasoning interpretively toward analytical generalisations about institutional conditions, rather than toward estimates of population parameters.

The analytical frame combines three established bodies of theory. Human-capital theory (Becker, 1964) supplies the economic rationale, treating micro-credentials as targeted, divisible investments in skills whose returns depend on their relevance to current production. Signalling theory (Spence, 1973) qualifies that rationale: a short credential conveys productivity information to employers only if its meaning is legible and trusted, which reframes the European emphasis on building trust as a signalling problem rather than a merely administrative one. Institutional isomorphism (DiMaggio & Powell, 1983) explains why universities adopt micro-credentials in broadly similar ways across very different systems, distinguishing coercive pressures, such as EU recommendations and accession conditionality, from mimetic imitation under uncertainty and the normative diffusion of shared standards through quality-assurance bodies and professional networks. Read together, the three lenses separate what micro-credentials are intended to do for the labour market from why institutions take them up, and on what condition the first depends.

The documentary corpus is organised on two levels. At the European level, the analysis examines the Council Recommendation on a European approach to micro-credentials (Council of the European Union, 2022), the European Skills Agenda, and the instruments that carry recognition across borders – the European Qualifications Framework, Europass and ESCO. At the national level, it analyses the Moldovan legal architecture governing partial qualifications: the Education Code (no. 152/2014), the National Qualifications Framework (Government Decision no. 330/2023), the Regulation on adult education (Government Decision no. 222/2024), the methodology that sets the five-to-sixty-credit envelope for micro-credentials (Order of the Ministry of Education and Research no. 785/2024), and the external quality-assurance methodology operated by the National Agency for Quality Assurance in Education and Research, ANACEC (Government Decision no. 616/2016). Each document is read for four attributes: how it defines a micro-credential, how it positions the credential relative to the qualifications framework, what stackability toward a full qualification it permits, and what quality-assurance route it imposes.

The comparative component examines a small number of European systems chosen on theoretical rather than representative grounds. Ireland and Estonia form the core, for two reasons: both are early movers whose national approaches are frequently cited as reference models, and both were the systems presented to Moldovan policymakers at the 2024 workshop convened in Chişinău by the International Labour Organization, which makes them the most policy-relevant comparators for this case. Germany and France enter as secondary references that illustrate university-led and consortium-led routes at an earlier stage of consolidation. The comparison is structured along six dimensions: the role assigned to the university relative to vocational, private and platform providers; placement against the national framework and ECTS; the accreditation and quality-assurance route; the rules governing stackability; the presence of public start-up funding; and the mechanisms that generate recognition and trust among employers. Moldova is then read against this matrix as the focal case.

Two limitations of the design should be stated at the outset. First, the study relies on public documents and on secondary evidence. It does not include a primary survey of employers, learners or university managers, and the statements made about take-up and demand are therefore inferred from policy texts and from reported practice rather than measured directly.

Second, the Moldovan legal framework is recent, with several of the key instruments adopted after 2023. The analysis consequently describes a system that is still in transition, and its conclusions about effectiveness depend on an implementation process that, at the time of writing, has only just begun.

4. Results and Discussion

4.1. Labour-market transformation and the response expected of universities

The argument advanced here rests on a mismatch between two rates of change. The first is the rate at which the skills embodied in the workforce lose economic value. The second is the speed at which the multi-year university degree, still the dominant instrument of formal qualification, can renew them. As long as the two rates were similar, a degree obtained in early adulthood remained serviceable for much of a career, and the role of the university could plausibly end at graduation. That assumption no longer holds. Surveying more than a thousand employers across 55 economies, the World Economic Forum estimates that 39% of workers' core skills will change by 2030 (down from 44% in 2023, but still close to two skills in five). The same survey reports that some 22% of jobs will be reshaped by 2030, that 63% of employers regard skills gaps as the principal barrier to business transformation, and that 59 of every 100 workers are expected to need reskilling or upskilling (World Economic Forum [WEF], 2025). The empirical premise from which the present analysis proceeds is the Forum's own conclusion: labour markets are evolving faster than education and training systems can adapt (WEF, 2025).

This mismatch is, fundamentally, a problem in the economics of human capital. In the framing proposed by Becker (1964), productive capacity is a stock that depreciates as the surrounding technologies and tasks change. When the rate of depreciation rises, the efficient response moves away from a single front-loaded investment and toward a sequence of smaller, recurrent investments timed to demand. The classical degree fits poorly with a high-depreciation regime. It bundles competences into a long and indivisible package, sets a relatively high entry threshold, and delivers its return only years after enrolment, at a point when the half-life of technical skills is already contracting. The micro-credential exhibits the opposite profile: it is small, divisible, current and quick to pay back. From a purely human-capital perspective, therefore, micro-credentials should be seen less as a pedagogical fashion than as a way of bringing the investment schedule into line with the new depreciation schedule.

Human-capital logic establishes the demand side of the case, but it does not, on its own, make a short credential economically valuable. The missing element comes from the signalling argument developed by Spence (1973). A credential raises the holder's earnings only to the extent that an employer is able to read it, that is, only if it conveys in a reliable way what its holder can actually do. The classical degree carries that information thanks to a century of accumulated convention. A three-week certificate, by contrast, does not, unless a trusted institution vouches for it. The European emphasis on trust and quality assurance should be read in this light. It is not so much administrative caution as a recognition of the central economic problem of the field: in the absence of a credible guarantor, micro-credentials are investments whose signal remains too noisy to be priced by the market. The question of who stands behind the credential is, for this reason, not secondary to the labour-market case. It is the question on which the realisation of that case depends, and it is the

reason why the institution from which a response is expected is the university, rather than any short-course provider.

Once the university is taken to be the institution from which a response is expected, the content of that response can be set out in concrete terms. Three functions can be distinguished, through which micro-credentials act on a worker's stock of human capital. Each of them addresses a distinct feature of the transformation described above, and the three are summarised in Figure 1. The first function is replacement: short, up-to-date units that substitute for competences which have become obsolete, and so offset the depreciation captured by the 39% skills-change figure. The second is unbundling: the division of a long qualification into stackable units distributed across a working life, so that a person already in employment can accumulate the full qualification in stages, without leaving the labour market. The underlying economic rationale is a reduction in opportunity cost (learning while earning), and this is the function with the greatest potential reach into Moldova's emigration-thinned and time-constrained adult workforce. The third function is augmentation: the addition of adjacent, in-demand competences to a qualification already held. This is the response to a labour market that increasingly rewards combinations of skills, for example a domain specialist who acquires competences in data analytics.

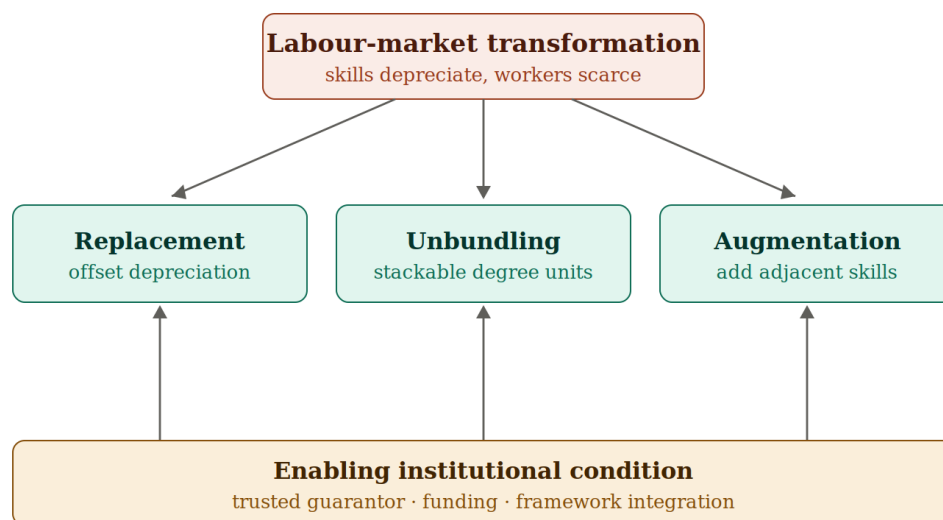


Figure 1. Three functions of micro-credentials and their enabling institutional condition

Source: authors' elaboration.

The three functions are not equally robust, and the second of them calls for a note of caution rather than celebration. Unbundling is at once the most powerful function and the most fragile, because it depends entirely on the guarantee that the individual pieces will stack toward a recognised qualification and that a part-finished stack will still signal something to employers. Once that guarantee is removed, unbundling degenerates into what the higher-education literature has labelled the unbundling threat: the degree is fragmented into saleable units, and its coherence, together with its signalling value, gradually erodes (Wheelahan & Moodie, 2022). This dependence is the analytical hinge of the framework. The function that responds most directly to labour-market pressure is also the one that depends most heavily on the enabling institutional condition shown beneath all three functions in Figure 1. Two further limits of the framework should be acknowledged. Because the framework is centred on the individual learner, it does not by itself address the equity risk that flexible provision will tend

to reach the already-qualified rather than the low-skilled (a live concern for Moldova's social-inclusion objectives), nor does it cover the separate question of recognising prior non-formal learning. What the framework asks of universities, in any case, is not the addition of a course catalogue, but a more substantial institutional reconfiguration: a shift from the certification of completed programmes to the certification of modular competence on a continuing basis, provided that the university retains its role as guarantor of the signal.

4.2. Evidence from European front-runners

The systems most often cited as successful in the European debate, and the two systems presented to Moldovan policymakers at the 2024 ILO workshop in Chişinău, show what such a reconfiguration looks like once it has been realised. They also confirm that its success turns on the enabling condition, rather than on the particular choice of legal form. Ireland built the response as a coordinated, university-led project. MicroCreds, a €14.3 million initiative led by the Irish Universities Association and financed through the Human Capital Initiative, made Ireland the first European country to establish a coherent national framework for quality-assured, accredited micro-credentials, all of them credit-bearing and aligned to the National Framework of Qualifications at levels 6 to 9 (Irish Universities Association [IUA], 2026). By early 2026, the project reported more than 20,000 learners and over 600 accredited micro-credentials across eight universities (IUA, 2026). Two design features explain the take-up achieved. Employers were built into the design from the outset, through an enterprise advisory group, and learners were given a single legible entry point through a national platform that operates as a trusted shopfront for accredited short courses. Translated into the terms of the previous subsection, Ireland resolved the signalling problem by placing the university in the role of accredited guarantor of the credential and the state in the role of funder, and these are the two conditions on which unbundling depends.

Estonia reached a comparable outcome through legislation rather than through a project, and the way it did so is the more instructive comparison for Moldova. The Estonian approach was developed through deliberate institutional preparation rather than through ad hoc legal change. The Education Sector Development Plan 2021-2035 had already identified, as one of its first strategic priorities, the creation of flexible and individualised learning paths built from smaller modular units that learners could assemble according to need; and, before legislating, the Estonian Ministry of Education and Research commissioned a detailed comparative study of international practice in order to inform the institutional design choices that the new instrument would require (Kivistik, Veliste, Käger, & Derevski, 2021). On the basis of this preparatory work, the Adult Education Act was amended in 2025 to give micro-qualifications a clear legal basis within continuing education (Riigikogu, 2025). The state then placed funding and universities behind the channel: a state-commissioned programme offers more than 1,500 free courses to roughly 26,000 people in 2025–2026, delivered by 37 institutions including universities (European Commission, 2025). The Estonian lesson for the present argument is therefore twofold. Routing micro-credentials through adult-education law is not, in itself, a weakness, provided that universities remain central to provision and that the provision is publicly funded. And the legal step is most effective when it is preceded by deliberate institutional preparation, including a careful comparative reading of international practice. By contrast, the more fragmented German and French routes – where provision is shared between universities and private platforms and standardisation is still being negotiated through bodies such as the European Consortium of Innovative Universities, and where France is still developing a national framework for quality and

recognition (Buimestru et al., 2025) – show weaker and more uneven take-up. Where the university is not placed at the centre with public backing, the signal stays weak. Table 1 sets these determinants of agility against the focal case.

Table 1. Determinants of university agility in micro-credential provision, selected systems

Determinant	Ireland	Estonia	Moldova
University role	Accredited guarantor; sector-led	Central provider	One provider among VET/private
Public start-up funding	€14.3m national project	State-commissioned courses	None dedicated
Quality-assurance signal	University-accredited, national framework	EKKA agency; EHIS registry	ANACEC external evaluation
Framework integration	NFQ levels 6–9, credit- bearing	EstQF; modular ECTS units	CNC; 5–60 credits
Employer linkage	Enterprise advisory group	Company–HEI training credit	Sectoral committees (nascent)
Observed take-up	20,000+ learners	High, university- central	Low

Source: authors' compilation based on IUA (2026), Riigikogu (2025), Kivistik et al. (2021), ETF (2025), and Buimestru et al. (2025).

What the two front-runners share is not a particular legal form but a common institutional posture. In both cases, the university is the accredited guarantor of the credential, the state finances early provision in order to overcome the cold-start problem, and a standing quality-assurance body ensures that the credential is legible to employers. Flexible learning came to operate as a genuine institutional response only in those settings in which universities had been placed in a position to lead it.

4.3. The regulatory environment: from the European framework to Moldova

The regulatory framework is best understood not as the subject of the response but as the environment that conditions how agile universities can be. At the European level, the Union has actively engineered that environment. The Commission signalled the intent in its 2020 communication on a European Education Area, and the Council Recommendation adopted in June 2022 defines a micro-credential as the record of the learning outcomes acquired following a small volume of learning and attaches common European descriptive elements to it (Council of the European Union, 2022). Read through institutional isomorphism (DiMaggio & Powell, 1983), the framework operates on universities coercively, through the Recommendation and, for a candidate state, accession-aligned expectations; normatively, as the European Qualifications Framework, Europass and ESCO carry shared standards into national quality bodies; and mimetically, through imitation of front-runners under uncertainty. The framework explains the convergence of designs; it does not, by itself, generate agility.

National legal choices then shape the channel. Romania legislated a university route directly, introducing short-cycle university studies of roughly 120 ECTS at qualifications-framework level 5 within its 2023 Higher Education Law (Parliament of Romania, 2023). Moldova has

assembled its architecture rapidly but through a different channel. The system rests on the Education Code (no. 152/2014), the National Qualifications Framework (Government Decision no. 330/2023) and the Regulation on adult education (Government Decision no. 222/2024), with the operative rules set by the methodology approved by Order no. 785/2024, which places micro-credentials between 5 and 60 study credits according to level and complexity, and external assurance run by ANACEC (Buimestru et al., 2025). The national definition aligns with the European one: a micro-credential is a set of learning outcomes from a short module, certified against unified standards for a given framework level, issued with a microcertificate, and combinable toward a full qualification (Buimestru et al., 2025). Measured against the three conditions of section 4.1 - framework integration, stackability and quality assurance – the Moldovan instruments are, on paper, broadly in place.

The binding constraint is, in consequence, institutional rather than legal, and it falls exactly where the agility argument would predict. Moldova channels micro-credentials predominantly through adult education and continuing professional training, where universities figure as one provider alongside vocational and private bodies, rather than through a distinct university-led route. The consequence is visible in the data. The European Training Foundation finds that adult participation in continuing education in Moldova remains low, in part because the available provision is limited and concentrated in cities, and that the coordination of adult-learning provision across the country's two main policy frameworks – Education 2030 and the National Employment Programme 2022-2026 - remains weak (ETF, 2025). This is not the Estonian pattern, in which the same legal channel works because universities are central to it and are publicly funded. It is the same channel, but without the two conditions that allow it to function. University engagement in Moldova is still nascent and largely voluntary. On the signalling logic developed above, the predictable result is a set of credentials that employers cannot yet read; and this in the one economy of the comparison that can least afford a slow response, given that nearly 30% of its people now live abroad, its working-age population has been shrinking since 2008, and the country's overall population could be nearly one-third smaller by 2050 (ETF, 2025).

4.4. *Synthesis*

The chain of reasoning that connects the labour market to the institution can now be drawn together. The accelerating depreciation of skills has pushed the renewal of human capital beyond what the degree cycle is able to carry. The micro-credential, being small and divisible, is the instrument that matches the new schedule, and it does so through the three functions of replacement, unbundling and augmentation. The instrument delivers, however, only where a trusted institution stands behind the signal that it transmits. That institution is the university, and the agility of its response is set by funding, by its placement within the qualifications framework, and by the body that guarantees quality. Ireland and Estonia supplied those conditions and their universities responded at scale. Moldova faces the sharpest version of the pressure and has built the legal environment, but it has not yet placed its universities in a position to occupy that environment. The shift toward flexible learning ultimately turns less on the design of courses than on the institutional equipping of those who are expected to certify them.

5. Conclusions

The paper has sought to identify the conditions under which micro-credentials function as a genuine institutional response by universities to the transformation of the labour market. The answer the analysis offers is reasonably clear. Because the rate at which skills lose economic value has come to exceed the renewal cycle of the degree, the small and divisible micro-credential is the instrument that matches the new investment schedule. It performs this role through three functions: the replacement of obsolete competences, the unbundling of long qualifications into stackable units, and the augmentation of qualifications already held with adjacent in-demand skills. None of the three, on its own, generates a labour-market return unless an institution makes the credential legible to employers. The decisive variable, in consequence, is not the particular legal form that a country adopts. It is whether the university is placed in the position of accredited guarantor of the signal, is financed to launch provision, and is fully embedded in the qualifications framework.

The comparison bears this out. Ireland and Estonia reached scale through different legal routes (a funded national project in the first case, an amendment to adult-education law in the second), but they converged on the same institutional arrangement: a university-centred system that is publicly funded and quality-assured. Moldova has assembled an equivalent legal architecture, but has not yet reproduced these enabling conditions. Micro-credentials in Moldova are channelled through adult education, with universities figuring as one provider among many and without dedicated funding or a guarantor role. The binding constraint on the Moldovan response is, therefore, the agility of its institutions rather than the content of its legislation.

Three policy implications follow for Moldova. The first is that universities should be placed at the centre of micro-credential provision in the capacity of accredited guarantors, since the certifying authority of the university is what can resolve the signalling problem that adult-education providers, on their own, are unable to resolve. The second is that the start-up phase requires dedicated public funding, whether in the form of a coordinated national initiative or in that of a state-commissioned scheme. Voluntary, unfunded engagement will not be sufficient to overcome the cold-start problem that is visible in the country's under-resourced provider network. The third is that, because the unbundling function is the most fragile of the three, policy should give priority to a guaranteed pathway through which stacked micro-credentials accumulate toward recognised qualifications, and should deliberately target learners outside the existing lifelong-learning population, so that flexible provision narrows skill inequalities rather than widening them.

The claims of the study are bounded by its design in three respects. The analysis is based on public documents and on secondary evidence, with no primary survey of Moldovan employers or learners, so its statements about effectiveness should be read as conditional inferences rather than as measured outcomes. The Moldovan framework is also recent, with several of the key instruments adopted in 2023 and 2024, and the analysis therefore describes a system that is still in transition; some of the conclusions may not capture implementation as it eventually unfolds. The comparison, finally, rests on two front-runner cases selected on theoretical rather than representative grounds, which supports analytical rather than statistical generalisation.

These limits point to two specific extensions of the research. A survey of Moldovan employers' recognition of micro-credentials, and of their willingness to reward holders of

such credentials in pay or in hiring, would put the signalling condition to a direct test and would convert an inferred mechanism into measured evidence. Once university provision has reached scale, a tracer study following learners through stacked micro-credentials would establish whether the unbundling function delivers the labour-market outcomes that the present analysis argues it can deliver. As the analysis also insists, however, this would be the case only under the institutional conditions specified here.

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ECONOMETRIC ASSESSMENT OF THE INFLUENCE OF FINANCIAL AND ECONOMIC FACTORS ON THE PRICES OF NEW HOMES IN BULGARIA (2015-2025)

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Abstract: This report presents an econometric model of type ARIMAX (0,2,1), developed to forecast and explain the dynamics of the House Price Index for New Dwellings in Bulgaria for the period 2015Q4–2025Q3 on a quarterly basis (40 observations in total). The model is based on a preliminary screening of 16 potential factors across four thematic groups: macroeconomic indicators, income and labour market, credit indicators, and investment and wealth. The objective is to identify statistically significant determinants of housing prices, assess the quality of the model, and formulate conclusions regarding its practical applicability for analysis and short-term forecasting of the new residential property market in Bulgaria.

Keywords: House price index, financial factor, economic factors, new dwellings, ARIMAX.

Classification JEL: R31, C22, E44.

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1. Introduction

This report focuses on the forecasting and explanation of the dynamics of the new housing price index in Bulgaria (HPIND) as of the date of the country's accession to the Eurozone (1.1.2026). The model is based on a preliminary screening of 16 potential factors distributed in four groups: macroeconomic indicators, income and labor market, credit indicators and investment and wealth. The collected database covers a period of 10 years and 40 quarters (2015Q4 – 2025Q3). The aim of the study is to identify statistically significant determinants of housing prices that have the best explanatory power at the time of Bulgaria's accession to the Eurozone. On this basis, ARIMAX (0,2,1) is built, whose focus is to analyze in an operational plan the market of new residential properties in Bulgaria by providing predictors for short-term price forecasting. The structure of the study includes data collection and their analysis through descriptive statistics; testing the 16 factors for stationarity, using ADF and KPSS tests; justification of the ARIMAX model (0,2,1); estimation of the ARIMAX model parameters and coefficients; estimation of the predictive qualities of the model (RMSE, MAPE, MAE, BIC, Ljung-Box & VIF); economic interpretations, structural conclusions and limiting characteristics of the model. The conclusion summarizes the model's key findings and strengths.

2. Literature Review

Household housing is a fundamental factor in economic theory. The study of the dynamics of these homes in terms of quantity and price provides an estimate of the growth of wealth and the tax base of municipal taxes and fees. For the purposes of the study, a focus was placed on four groups of predictors: macroeconomic indicators, income and labor market, credit indicators,

investment and welfare, although there are also studies that cover an even larger number of influencing factors (Zahariev, Zaharieva, Shaulska, Larysa, & Oryekhov, 2026).

In the first group, the focus on GDP and/or its components finds a number of confirmations of its influence on housing prices (Algieri, 2013). In these studies, GDP is identified as the main factor influencing housing prices (Li & Zeng, 2010), (Cohen & Karpavičiūtė, 2017), (Ubarevičienė & Aidukaitė, 2026), (Mazáček & Panoš, 2025). Housing prices are also influenced by regional factors (Prodanov & Naydenov, 2020), (Sabitova, Shavaleyeva, Lizunova, Khairullova, & Zahariev, 2020), but also by supply and demand factors (Stroebe & Vavra, 2019). However, the influence of inflation is assessed at two levels - when examining final housing prices, but also when assessing the factors forming the cost of housing (Kuang & Liu, 2015). The latter stands out with particular force in the new era (Anari & Kolari, 2002), (Cohen & Karpavičiūtė, 2017). Other studies focus on factors influencing the effective demand for new housing. Workers' incomes (McQuinn & O'Reilly, 2008) and employment indicators in the labor market (Irandoost, 2019) are included in a number of studies on house prices (Girouard, Kennedy, Noord, & André, 2006). Credit conditions for purchasing houses naturally complement the income and savings capacity of households. Important factors here are mortgage interest rates (McQuinn & O'Reilly, 2008), (Lin, Lee, & Newell, 2022) and housing credit dynamics. In the final fourth place is the attraction of foreign investors in housing (Ouhinou, et al., 2025) and the attractiveness of alternative investments through the stock exchange (Zaharieva, Tarakchiyan, & Zahariev, 2022) and the currency market volatility (Jacque, L., 2025).

3. Methodology, Data and Descriptive Statistics

3.1 Description of Dependent and Independent Variables

The dependent variable HPIND (House Price Index for New Dwellings, 2015=100) is published by the National Statistical Institute (NSI) and reflects changes in the price level of newly built residential properties. Over the study period, the index increased 2.32 times (from a basic value 100 to approximately the value of 232), with a mean of 147.52 points, a standard deviation of 37.00 points, and a coefficient of variation of 25.08%, indicating moderate dispersion around the mean. During model construction, 17 indicators (including the dependent variable) were examined, systematised into four groups: (a). Macroeconomic Factors (5 variables): GDP, Exports, Imports, HICP (Harmonised Index of Consumer Prices) and GDP per capita; (b) Income & Labour Market (3 variables): Average Gross Quarterly Wages and Salaries, Unemployment coefficient and Labour Force; (c) Credit Indicators (6 variables): Dwelling Credits (DwCr), Interest Rate, Bank Loans Secured by Residential Property, Household Interest Costs on Mortgage Loans, Bad and Restructured Housing Loans (BLRSP), and Mortgage Interest Rate in BGN; (d) Investment & Wealth (3 variables): Net Foreign Investment in Dwellings (NFID), EUR/USD exchange rate, and BSE index SOFIX.

3.2 Key Features from Descriptive Statistics

The analysis of descriptive statistics reveals considerable heterogeneity in indicator dynamics. The highest coefficient of variation belongs to bad and restructured housing loans (BRHL – 57.36%), reflecting credit portfolio quality volatility. Bank loans secured by residential property (BLSRP – 43.82%) and dwelling credits (DwCr – 34.65%) also show high variability. The lowest variability is found in labour force (LF – 4.47%), net foreign investment (NFIP – 4.80%) and EUR/USD (ExR - 4.84%). Over the full period (2015Q4 –

2025Q3), bank loans secured by residential property recorded the most substantial growth, expanding 3.83 times relative to the base period (t40/t1). Dwelling credits followed with a 2.89-fold increase, while average gross wages grew 2.83 times and GDP expanded 2.75 times compared to the starting point. These dynamics confirm that the Bulgarian housing market operated in an environment of sustained economic expansion.

3.3. Stationarity Testing (ADF and KPSS)

A prerequisite for the correct application of an ARIMA/ARIMAX model is establishing the order of integration of each series. Two complementary tests are applied: ADF (Augmented Dickey-Fuller) – null hypothesis of unit root (non-stationarity) - and KPSS (Kwiatkowski–Phillips–Schmidt–Shin) - null hypothesis of stationarity. The results show that almost all series are integrated of order I(2), becoming stationary only after second-order differencing. Exception factors are HICML and NFID: I(1) with stationary after first differencing, and HICP and BLSRP: with unclear integration order (contradictory ADF and KPSS results), and they are excluded from further analysis. The basic rule of the research is that if including series with indeterminate integration structure that would yield incorrect estimates. At that stage the key finding is since the dependent variable HPIND is I(2), second-order differencing is required, reflected in the model structure - ARIMA(0,2,1). The best fitting statistical significance independent variables retained in the model are EXP, IMP, and DwCr which are also I(2). On that base we are ensuring integration order homogeneity - a mandatory condition for an ARIMAX specification.

4. Results and Discussion

4.1. Structure and Specification of the ARIMAX (0,2,1) Model

The estimated model is ARIMAX(0,2,1) - an ARIMA model augmented with exogenous regressors. Written in analytical form, after second-order differencing of all series the model formula is expressed with following variables and coefficients:

$$\Delta^2 \text{HPINH}_t = \beta_1 \times \Delta^2 \text{EXP}_t + \beta_2 \times \Delta^2 \text{IMP}_t + \beta_3 \times \Delta^2 \text{DwCr}_t + \theta_1 \cdot \varepsilon_{t-1} + \varepsilon_t \quad (1)$$

where Δ^2 denotes the second-order differencing operator, θ_1 is the moving average coefficient MA(1), and ε_t is the error term. The absence of an autoregressive component (AR=0) means that past values of the index are not included directly; inertia is captured solely through the MA(1) term. From the initial 16 indicators, following stationarity tests and regression screening, three exogenous factors are retained in the final model (See Table 1).

Table 1. Exogenous factors of ARIMAX(0,2,1) model

Factor	Description	Direction	Interpretation
EXP_D2	Exports (2nd difference)	(+) Positive	Rising exports signal economic expansion and increased residential demand
IMP_D2	Imports (2nd difference)	(-) Negative	Accelerating imports reflect consumer demand for goods rather than housing
DwCr_D2	Dwelling Credits (2nd difference)	(+) Positive	Expansion of mortgage lending directly stimulates demand and drives housing prices upward

Source: Author calculations with IBM SPSS

4.2. Assessment of Model Parameters

The MA(1) coefficient is estimated at $\theta_1 = 0.980$ (SE = 0.430; $t = 2.282$; $p = 0.029$). The value is positive, close to unity, and statistically significant at $\alpha = 0.05$. The high value of θ_1 indicates that the current change in the index is strongly conditioned by the error of the preceding period, reflecting a substantial inertial component in housing price dynamics. In case that value near 1.0 lies at the practical boundary of MA invertibility ($|\theta| < 1$) it should be monitored carefully when the model is updated with new observations.

Table 2. Significance assessment of ARIMAX(0,2,1) parameters

Predictor	B	SE	Beta	t-stat	p-value	95% CI Lower	95% CI Upper	VIF
EXP_D2	0.002	0.001	0.396	2.357	0.024 *	0.000	0.003	1.316
IMP_D2	-0.003	0.001	-0.534	-2.724	0.010 **	-0.005	-0.001	1.793
DwCr_D2	0.011	0.006	0.338	1.756	0.088 (“)	-0.002	0.023	1.730
* $p < 0.05$; ** $p < 0.01$; “ marginally significant ($p < 0.10$)								

Source: Author calculations with IBM SPSS

Regarding the interpretation of the obtained model coefficients we can share following arguments: (a) The Exports (EXP_D2) has $B = 0.002$, positive and statistically significant ($p = 0.024$). The Standardised Beta = 0.396 ranks it as the second most important predictor. Economically, accelerating exports drive as a proxy for economic growth and rising incomes, and are associated with upward pressure on housing prices. The partial correlation ($r = 0.370$) is moderate; (b) The Imports (IMP_D2) has $B = -0.003$, negative and highly significant ($p = 0.010$). The Standardised Beta = -0.534 makes it the most influential predictor in absolute terms. Economically, accelerating imports reflecting domestic demand for foreign goods, and it is are inversely related to housing price dynamics. When imports surge, disposable resources for residential investment likely diminish, or import growth signals consumer spending that competes with housing investment; (c) The Dwelling Credits (DwCr_D2) has $B = 0.011$, positive and marginally significant ($p = 0.088$), at the 10% threshold, not passing the conventional 5% level. Standardised Beta = 0.338 places it third in importance. The 95% confidence interval spans zero (-0.002; 0.023), meaning the effect may vanish under structural change or smaller samples. Nevertheless, the economic rationale is strong – mortgage lending is the primary financing mechanism for housing purchases.

4.3. Assessment of the Model Quality

Table 3 represent forecast accuracy measures. The combination of MAPE = 1.68% and $R^2 = 0.993$ positions the model as exceptionally accurate for practical purposes. Important caveat: $R^2 = 0.993$ must be interpreted cautiously in I(2) models, since second-order integration inherently generates smooth, highly correlated series. The stationary R^2 of 0.666 is the more informative measure of in-sample fit. The Ljung-Box Q(18) test yields $Q = 23.465$ with 17 degrees of freedom and $p = 0.135 > 0.05$. The null hypothesis of no autocorrelation in residuals is not rejected. This is a key diagnostic result: residuals behave as white noise, confirming that the model has captured the systematic structure in the data and that the ARIMA specification is adequate.

Table 3. Forecast accuracy of ARIMAX(0,2,1) model

Factor	Description	Econometric Interpretation
Stationary R ²	0.666	Model explains ~67% of variation in differenced series
R ² (overall)	0.993	Exceptionally good coverage of original series levels (I(2) models naturally yield high R ² by construction)
RMSE	3.195	Root mean square error of ~3.2 index points – acceptable given a mean value of 147.52
MAPE	1.683%	Mean absolute percentage error below 2% - excellent forecast precision
MAE	2.511	Mean absolute error of ~2.5 index points
MaxAPE	3.707%	Maximum percentage error below 4% - no forecast anomalies
MaxAE	7.066	Maximum absolute error of ~7 points (~4.8% of mean level)
Normalised BIC	2.706	Information criterion for model selection – lower is better; useful for comparing alternative specifications
Stationary R ²	0.666	Model explains ~67% of variation in differenced series - good fit

Source: Author calculations with IBM SPSS

VIF values for the three predictors are: EXP_D2 = 1.316, IMP_D2 = 1.793 and DwCr_D2 = 1.730. All values are below the threshold of 5, indicating an absence of problematic multicollinearity. Tolerance values (0.760, 0.558 and 0.578 respectively) are all above 0.2, confirming that multicollinearity does not undermine the reliability of the parameter estimates. The model registers no outliers (Outliers = 0). This is a positive indicator of data robustness and internal consistency – no corrections for extreme values are required.

5. Conclusions

The final ARIMAX specification retains three explanatory variables (Exports, Imports, and Dwelling Credits). Each of them is based on well-established economic logic and reflects different mechanisms through which macroeconomic conditions affect the dynamics of residential property prices and especially new dwelling. Of particular theoretical significance is the role of the trade balance. The combination of a statistically significant positive export effect and a negative import effect jointly captures the influence of the net export position on housing prices: a favourable trade balance is associated with upward price pressure, insofar as export-oriented activity generates income and employment that strengthen effective housing demand, while accelerating import growth may signal a reorientation of household expenditure away from real estate toward consumer goods and services. The credit channel, although marginally significant ($p = 0.088$), remains a substantively important dimension of the model. Dwelling credits reflect the central role of financial intermediation in housing price formation, as expansion in mortgage lending directly amplifies effective demand for new dwellings – a relationship consistent with the classical credit accelerator mechanism. The attenuated significance level may be attributable to lag structure effects or partial collinearity with the trade-side predictors rather than to an absence of genuine economic relevance. Despite the model's satisfactory econometric performance, the analysis reveals the absence of several indicators that carry considerable theoretical weight in housing price determination. Variables such as wages, unemployment, mortgage interest rates, and the stock exchange index were not retained in the final specification

despite their conceptual relevance to residential property markets. This outcome may reflect that their influence is captured implicitly through the included predictors, or alternatively, it may indicate genuinely weak linear associations with the second-differenced dependent series over the sample period under examination.

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STRATEGIC ORGANIZATIONAL TRANSFORMATION THROUGH SUSTAINABLE LEADERSHIP

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Abstract: Strategic organizational transformation represents a complex and essential process for organizations seeking to remain competitive in an environment shaped by rapid change, economic pressures, and social and environmental challenges. Within this framework, sustainable leadership emerges as a key driver in guiding and strengthening long-term transformation initiatives. This paper explores the role of sustainable leadership in supporting strategic organizational change, with particular emphasis on the integration of ethical principles, social responsibility, and economic performance. The study highlights how leaders can shape organizational culture and create favorable conditions for innovation, adaptability, and employee engagement. By promoting sustainable values and a coherent strategic vision, leadership contributes to aligning organizational objectives with the expectations of society and environmental requirements. Furthermore, the research discusses the core competencies needed by leaders to manage transformation processes effectively, including strategic communication, responsible decision-making, and the development of human capital. The findings indicate that sustainable leadership is not merely a contemporary managerial approach but a critical requirement for ensuring organizational resilience and long-term success. The implementation of sustainability-oriented strategies supports improved organizational performance, strengthens stakeholder trust, and enables the achievement of a lasting competitive advantage. This study also provides valuable insights for both academic research and managerial practice, emphasizing the importance of integrating sustainability into strategic leadership frameworks.

Keywords: sustainable leadership, organizational culture, sustainability, development.

Classification JEL: M10, M12.

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1. Introduction

In a global environment marked by increasing dynamism and interconnectivity, organizations are under growing pressure to rethink their strategic direction in order to remain competitive, resilient, and socially responsible.

Strategic organizational transformation is no longer a one-time effort, but a continuous process that requires not only structural and operational changes, but also a shift in leadership approaches. In this context, sustainable leadership becomes an important factor in guiding organizations toward long-term success while addressing environmental and social challenges.

Unlike traditional leadership models, which focus mainly on short-term financial performance, sustainable leadership promotes a broader view of value creation. It combines economic goals with social responsibility and environmental protection, encouraging strategies that are viable in the long term.

Organizations are no longer evaluated only based on profit, but also on their ability to demonstrate transparency, accountability, and ethical behavior. In this context, leaders must deal with complex and sometimes conflicting demands, balancing efficiency with responsibility and innovation with risk management.

When guided by sustainable leadership, strategic transformation goes beyond operational improvements and involves redefining the organization's purpose, culture, and governance structures. Leaders play a key role in building a shared vision, promoting ethical decision-making, and integrating sustainability principles into core organizational processes. This type of transformation becomes even more important in the context of global challenges such as climate change, resource scarcity, and social inequalities, which require coordinated and forward-looking responses.

In addition, sustainable leadership helps strengthen organizational resilience by promoting adaptability and long-term thinking. By encouraging continuous learning, stakeholder engagement, and responsible innovation, it enables organizations to respond effectively to uncertainty and rapid change. In this way, sustainability is no longer just a compliance requirement but becomes a strategic driver of transformation and competitive advantage.

In this context, understanding the relationship between sustainable leadership and strategic organizational transformation is essential for both academic research and managerial practice. This perspective highlights the importance of aligning leadership styles with sustainability goals in order to ensure long-term organizational success and a positive impact on society.

2. Literature Review

The academic literature on strategic organizational transformation through sustainable leadership shows a growing interest in the intersection between leadership theories, sustainability, and long-term organizational performance.

Researchers emphasize that the complexity of the current environment requires leadership models that go beyond traditional profit-oriented approaches and integrate social and environmental dimensions.

Unlike conventional leadership styles, it focuses on preserving organizational resources and capabilities for the benefit of future generations. This perspective aligns with the principles of sustainable development, which promote a balance between economic growth, social equity, and environmental protection.

Research on organizational transformation highlights the critical role of leadership in shaping the direction and outcomes of change processes. Sustainable leaders are viewed as facilitators of transformation, capable of aligning organizational strategies with sustainability objectives while fostering an organizational culture based on responsibility and innovation.

Another important aspect highlighted in the literature is the role of organizational culture in supporting sustainable transformation. Leadership is expected to actively promote the integration of sustainability into the organization's values and practices.

This process involves not only formal policies and strategies, but also informal norms that influence how decisions are made and implemented. Organizations that adopt sustainable leadership practices are better prepared to anticipate and respond to external pressures, including regulatory changes and evolving market demands.

Sustainable leaders are expected to consider the interests of a wide range of stakeholders, including employees, customers, communities, and investors. This inclusive approach leads to more balanced decision-making and reduces the risk of conflicts or unintended negative impacts, while also contributing to the development of more resilient and socially responsible organizations.

3. Methodology

This study adopts a research approach aimed at exploring the relationship between sustainable leadership and strategic organizational transformation. The research is grounded in a conceptual and interpretive analysis of the existing literature, including academic articles, books, and relevant theoretical frameworks in the fields of leadership, organizational transformation, and sustainability.

The sources were selected using a structured approach, focusing on studies that address the principles of sustainable leadership, organizational change management, stakeholder engagement, and long-term strategic development. This approach enables the synthesis of existing knowledge and facilitates the identification of key patterns, themes, and relationships within the field.

These themes were subsequently organized into a coherent framework to support a clearer understanding of how sustainable leadership contributes to organizational transformation. To ensure the rigor and validity of the findings, the study relies on multiple academic sources and the comparison of different theoretical perspectives.

The scope of the research is primarily theoretical and exploratory. As such, the study does not involve the collection of primary data, such as surveys or interviews, but instead focuses on synthesizing existing knowledge to provide a conceptual foundation regarding the role of sustainable leadership in strategic organizational transformation.

In conclusion, the adopted methodological approach enables a systematic and structured analysis of the literature, supporting the development of a coherent analytical perspective on the role of sustainable leadership in shaping long-term organizational change. This approach also provides a solid foundation for future empirical research that could validate and further expand the conceptual findings presented in this study.

4. Results and Discussion

In this section, we will analyze leadership, organizational performance and sustainability perspective. The focus is on how organizations operate in a way that meets present needs without compromising the ability of future generations to meet their own needs. The sustainability perspective involves the balanced integration of three main dimensions: economic, social, and environmental. Therefore, organizational performance is no longer evaluated solely through financial indicators, but also through its impact on society and the environment. Organizations that adopt this approach aim not only for short-term profit but also for long-term value creation through responsible practices, innovation, and adaptability.

Leadership has a long developmental history, evolving across three main contexts: conceptual, practical, and research-oriented. The emergence of these contexts has been driven primarily by the relationship between the practical and the scientific dimensions of

leadership development, as well as by the need to highlight the human and social capital operating within organizations. Throughout this evolutionary process, the internal structure of organizations has been shaped by principles of organization and hierarchy, including the distribution of decision-making power.

At the same time, leadership is profoundly influenced by the development process. On the one hand, leadership plays an essential role within organizations in ensuring the sustainability of organizational change processes. On the other hand, leadership is also shaped by external developments, as changes in the external environment can affect organizational transformations, requiring leaders to adapt accordingly. This capacity for adaptation naturally depends on leader's skills, qualities, and performance in managing both present and future organizational changes.

One of the ways in which leadership can create stability during periods of change is through the use of ethical values within the organization. When leaders adopt an ethical approach that is aligned with the interests of all stakeholders, rather than solely their own, the conditions for sustainable and successful change are established.

In this regard, a high level of ethical leadership contributes to the achievement of positive change. The ethical conduct of leaders, when aligned with the objectives of stability and sustainability in the organizational change process, becomes a determining factor for success. During critical periods of change that test organizations, leadership behavior and ethics are essential elements for successfully overcoming these challenges.

Conversely, if leadership adopts unethical behavior and seeks to exploit interpersonal relationships within the organization, this significantly undermines both the capacity to adapt to change and the sustainability of the organizational transformation process. The future is characterized by uncertainty and challenges driven by continuous organizational change. In this context, organizational advantages become essential and can be achieved in organizations where leaders and their teams possess the appropriate knowledge, competencies, and qualities.

These attributes facilitate adaptation and support the transformation of the organization within a new organizational environment. When leadership reaches this level of development, it becomes necessary to apply and further develop organizational change methods that are sustainable throughout the entire duration of the process. (Raçi, 2015)

Digital sustainability represents an emerging paradigm that examines how data and digital applications contribute to sustainable development. While initial lines of research on sustainable information systems primarily focused on minimizing environmental impacts, contemporary perspectives increasingly adopt a more nuanced and holistic view of the social and environmental implications of technology.

However, this broadened perspective is accompanied by growing complexity. It requires both researchers and practitioners to navigate tensions between competing and seemingly incompatible objectives, as well as between the positive and negative consequences of technological interventions, whether these outcomes are intentional or unintended. Tensions refer to two or more interdependent oppositional forces that coexist in a state of dynamic contradiction and continuously drive conflict and change.

Failing to address these tensions would undermine the complex and multidimensional nature of sustainability. Moreover, tensions between positive and negative narratives can be

observed in the context of digital technologies. Examples include technostress, the spread of misinformation, environmental harm resulting from energy intensive applications, and algorithmic discrimination.

Current understandings emphasize the broad impact of digital technologies across sustainability dimensions, while devoting comparatively less attention to the potential conflicts that arise from adopting such an inclusive perspective. As technologies generate both new opportunities and unintended or even harmful consequences, their outcomes need to be actively managed before, during, and after implementation in real world contexts.

Sustainability goals broadly refer to the overarching aim of contributing to an economic, environmental, and social objective, or to the identification of a sustainability related problem that should be addressed through digital technologies. Beyond the specific objectives of digital sustainability, outcome dimensions are also relevant for the general design and use of technologies that pursue non sustainability goals yet give rise to various consequences. (Schoormann, 2025)

An increasing number of organizations are actively investigating how artificial intelligence can be leveraged to advance their sustainability goals. By integrating AI-driven solutions, these companies aim to lower their carbon footprint, optimize resource use, and play a meaningful role in building a more environmentally responsible and sustainable future (Microsoft, 2026).

In today's world, sustainability challenges are becoming more intricate and interconnected than ever before. However, a growing number of organizations and communities are addressing these issues by incorporating artificial intelligence solutions into both their operations and decision-making structures. Reaching true sustainability demands a holistic perspective, where the economic, social, and environmental dimensions are not treated separately but are integrated into core strategies and everyday practices. (EcoActive, 2024)

Organizational sustainability is a comprehensive concept that emphasizes the ability to achieve long-term operations across three primary dimensions: economic, social, and environmental. Organizations must pursue economic growth while focusing on social well-being and environmental protection to ensure that re-sources and wealth are equitably shared across multiple generations. Assessing organizational sustainability involves traditional economic performance, as well as social and environmental performance, reflecting the equal importance of these three aspects. This management approach is defined as the processes or structures organizations use to transform inputs into products or services to achieve their sustainability goals.

Successful sustainability practices require the coordination and integration of leadership, strategy, structure, and systems. Despite these challenges, systematic research and continuous efforts can support sustainability. The corporate philosophy of sustainability views sustainability not only as a responsibility but also as an opportunity, requiring organizations to comprehensively consider economic, environmental, and social factors.

Human resource management plays a critical role in supporting organizational sustainability goals through the development of employees' digital capabilities and the enhancement of social performance. The development of organizational identity is a dynamic process that reflects both the external image and shared understanding of internal members.

Measures such as sustainability reporting and engagement in management activities can strengthen this identity. Additionally, promoting organizational sustainability requires consideration of the interplay between internal and external factors, with information technology playing a crucial role (Cheng, 2025). Organizational Agility has emerged as a critical dynamic capability that enables firms to sense and respond swiftly to shifts in the external environment.

Defined as the ability to rapidly adapt through strategic or operational adjustments, organizational agility is essential for navigating uncertainty and seizing emerging opportunities in dynamic market conditions. Within the context of sustainable transformation, agility represents an organization's capacity to continuously realign resources and strategies to maintain long-term competitiveness. It involves the integration of internal competencies and external sensing mechanisms, allowing firms to act decisively in turbulent contexts. Beyond speed, agility emphasizes flexibility, learning, and resource reconfiguration features that are indispensable for achieving resilience and sustaining competitive advantage in digitally driven industries.

Scholars have conceptualized organizational agility through two complementary dimensions: operational adjustment agility and market capitalizing agility. The former refers to an organization's capacity to reconfigure internal routines, structures, and processes in response to environmental change, thereby improving internal efficiency and responsiveness. In the context of digital transformation, organizational agility is increasingly recognized as a key enabler that bridges digital capability with business performance. Agile organizations are more capable of integrating digital technologies such as cloud computing, artificial intelligence, and big data analytics into core operations, thereby accelerating decision-making, fostering collaboration, and promoting continuous innovation.

Finally, organizational agility is increasingly viewed not only as a reactive capability but as a proactive strategic asset that supports organizational ambidexterity. Agile firms are better equipped to balance exploitation of existing competencies with exploration of new opportunities, allowing for sustained innovation and adaptability in uncertain markets.

Within this study, organizational agility is explicitly positioned as a central process mechanism through which digital transformational leadership influences digital transformation and, ultimately, sustainable organizational performance (Alhameed, 2025). Organizational performance represents a multifaceted construct reflecting a firm's ability to achieve strategic objectives efficiently and effectively. It encompasses financial outcomes, operational efficiency, and stakeholder satisfaction.

In the context of this study, organizational performance is viewed as an indicator of sustainable transformation, capturing a firm's capacity to maintain competitiveness and resilience over time. Equally important is organizational agility, which allows firms to continuously adapt and sustain performance under uncertainty.

Taken together, these insights underscore that organizational performance is not the result of isolated initiatives but the cumulative outcome of leadership-driven capability development. Accordingly, organizational performance is positioned as the ultimate outcome of a leadership-enabled process involving agility and digital transformation, reinforced by a supportive digital culture. (Alhameed, 2025)

5. Conclusions

In conclusion, the analysis highlights that sustainable organizational performance emerges from the dynamic interplay between leadership, digital transformation, and organizational agility within an increasingly complex and uncertain environment. Leadership plays a pivotal role not only in guiding organizational change but also in ensuring that such transformations are aligned with long-term sustainability objectives across economic, social, and environmental dimensions.

Ethical and adaptive leadership, grounded in the effective use of human and social capital, fosters stability during periods of change and enables organizations to respond to external pressures. At the same time, the integration of digital technologies introduces both opportunities and tensions, requiring careful management to balance innovation with potential social and environmental consequences.

Organizational agility acts as a critical mechanism that connects leadership intent with the successful implementation of digital transformation, allowing firms to continuously reconfigure resources, respond to market dynamics, and sustain competitive advantage. In this context, performance can no longer be assessed solely through financial outcomes, but must incorporate broader indicators reflecting resilience, adaptability, and societal impact.

Ultimately, achieving sustainable organizational performance requires a holistic and integrated approach, where leadership, strategy, technology, and organizational capabilities are aligned to support continuous transformation. This reinforces the idea that long-term success is not the result of isolated initiatives, but of coherent, leadership-driven processes that balance innovation, ethical responsibility, and sustainability.

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BURNOUT AND ORGANIZATIONAL EFFICIENCY: IMPLICATIONS FOR HUMAN RESOURCE MANAGEMENT

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Abstract: *In the context of contemporary organizations, characterized by dynamism, globalization and increased pressure for performance, employee well-being has become a central element of organizational efficiency and sustainability. Burnout, defined as a syndrome resulting from chronic occupational stress, manifests itself through emotional exhaustion, depersonalization and a reduced sense of professional efficacy, with significant consequences for individuals and organizations. Specialized studies highlight the fact that this phenomenon negatively affects the motivation, productivity, professional involvement and psychophysical health of employees, contributing to increased absenteeism and staff turnover. In this context, human resource management plays a strategic role in preventing and managing burnout by implementing appropriate organizational policies, such as optimizing work tasks, developing supportive leadership and promoting work-life balance. Also, the periodic assessment of psychosocial risks and the creation of a positive organizational climate contribute to reducing the impact of occupational stress. Therefore, the integrated approach to burnout is an essential condition for maintaining organizational performance and employee health in the current work environment.*

Keywords: *burnout, organizational efficiency, occupational stress, employee well-being, job demands–resources model, organizational performance, workplace mental health, job satisfaction.*

Classification JEL: *M 54, I 10, I 31, O 15, J 28.*

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1. Introduction

In the context of accelerated transformations of the contemporary organizational environment, marked by globalization, digitalization and intensified competition, human capital is becoming a strategic determinant of organizational performance. Organizations are subject to increasing pressures for adaptability, innovation and productivity, which often leads to increased professional demands on employees. In this context, the well-being of human resources is no longer just a secondary concern, but a fundamental condition for organizational sustainability and efficiency (WHO, 2019; Bakker & Demerouti, 2017).

An increasingly frequently investigated phenomenon in the specialized literature is burnout, initially conceptualized by Herbert Freudenberger and later developed by Christina Maslach, as a form of professional exhaustion characterized by three main dimensions: emotional exhaustion, depersonalization and reduced personal accomplishment (Freudenberger, 1974; Maslach & Jackson, 1981). Burnout occurs in response to chronic stress at work and has significant implications at both the individual and organizational levels (Maslach & Leiter, 2016).

At the individual level, burnout manifests itself through decreased motivation, deterioration of mental and physical health, and diminished job satisfaction (Bianchi et al., 2015). At the organizational level, the effects include reduced productivity, increased absenteeism and staff turnover, and impaired organizational climate (Shanafelt et al., 2015; Gallup, 2020). Thus, burnout becomes a critical factor that influences organizational efficiency and overall performance.

From the perspective of human resource management, addressing burnout involves the development of integrated prevention and intervention strategies, which include work-life balance policies, psychological support programs, empathetic leadership, and work design optimization (Bakker & Demerouti, 2017; Kossek et al., 2012). In this sense, human resource management takes on a strategic role in promoting organizational health and creating a sustainable work environment.

The purpose of this article is to analyze the relationship between burnout and organizational effectiveness, highlighting the implications for human resource management practices. The paper also aims to identify the mechanisms through which burnout affects organizational performance and to provide directions for action to reduce it within modern organizations.

2. Literature Review

The concept of burnout emerged and consolidated as a result of independent research conducted in different occupational contexts, but converging in highlighting the negative effects of chronic stress on individuals in the work environment. The specialized literature reflects a gradual conceptual evolution, characterized by the diversification of definitions and measurement instruments, which highlights the complex and multidimensional nature of the phenomenon (Maslach & Schaufeli, 2001; Schaufeli et al., 2009).

From a semantic perspective, the term “burnout” designates the progressive depletion of the individual’s physical and mental resources, as a result of prolonged exposure to high professional demands. This interpretation is congruent with the general meaning of exhaustion, which implies the diminution of functional capacity following a sustained and excessive effort.

The first conceptualizations of burnout are attributed to Herbert Freudenberger, who described the phenomenon as a state of profound exhaustion, accompanied by cynicism towards work and a decreased sense of personal efficacy (Freudenberger, 1974). Later, Christina Maslach operationalized the concept, defining it as a psychological syndrome composed of three fundamental dimensions: emotional exhaustion, depersonalization, and reduced personal accomplishment, especially in professions that involve intense interaction with other people (Maslach & Jackson, 1981).

In this context, constant interaction with work beneficiaries (e.g., clients, patients, or students) is identified as a major risk factor. Repeated exposure to ambiguous or difficult-to-solve situations contributes to an increase in the level of perceived stress and, over time, to the onset of burnout. Initially associated with human service professions, the concept was later extended to all occupations, reflecting the universality of psychosocial risks at work (Maslach, Schaufeli & Leiter, 2001).

A significant contribution to the systematization of the specialized literature belongs to Wilmar Schaufeli and collaborators, who synthesized the evolution of the concept and highlighted the transition from a restrictive occupational perspective to an organizational and transversal one. They argue that burnout should be understood as a generalized occupational phenomenon, determined by the imbalance between job demands and resources (Schaufeli et al., 2009; Bakker & Demerouti, 2017).

Regarding the measurement of burnout, the most widely used method is self-assessment using standardized instruments. The best-known instrument is the Maslach Burnout

Inventory, which assesses the three dimensions of the syndrome: emotional exhaustion, depersonalization, and reduced personal accomplishment (Maslach & Jackson, 1981). Although this instrument is widely used due to its psychometric validity, the literature highlights limitations related to the subjectivity of responses and cross-cultural variations in the interpretation of items (Schaufeli et al., 2009).

Recent empirical research uses both quantitative and qualitative or mixed methodologies, reflecting the diversity of approaches to studying the phenomenon. Ahola and colleagues point out the existence of significant variations in the operationalization of burnout, which affects the comparability of results across studies and different cultural contexts (Ahola et al., 2010).

At the European level, comparative studies show an uneven distribution of research on burnout, with cross-sectoral investigations identified in countries such as Germany, Finland, the Netherlands or Belgium. However, in many other contexts, research is predominantly sectoral and focuses on associated constructs, such as occupational stress or job satisfaction (Eurofound, 2018).

The extension of the concept beyond human service professions to creative, technical or organizational fields highlights its transversal character. Thus, burnout is increasingly conceptualized as a result of the interaction between individual, organizational, and cultural factors, rather than as a phenomenon specific to certain professions (Bakker & Demerouti, 2017).

The conceptual evolution of burnout reflects the shift from a profession-specific approach to an integrative one that recognizes the complexity of the phenomenon and its implications for organizational effectiveness. The diversity of definitions and measurement methods highlights the need for conceptual and methodological standardization in order to develop effective interventions in human resource management (Maslach & Leiter, 2016).

3. Methodology

This study adopts a theoretical-conceptual analysis approach, aiming to explore the relationship between burnout and organizational effectiveness, as well as highlighting the implications for human resource management. The methodology is based on a systematic and narrative review of the specialized literature in the field of organizational psychology, human resource management and occupational health. The research has a qualitative, non-empirical design, based on a critical and synthetic analysis of relevant theoretical and empirical studies. This approach is appropriate for clarifying concepts, identifying dominant theoretical models and highlighting current trends in the specialized literature.

4. Results and Discussion

Tools used to assess burnout

The assessment of burnout has been a constant concern in scientific research, leading to the development of a wide range of measurement tools. These tools reflect the diversity of burnout conceptualizations, but have as a common element the central idea of burnout, present since the early works of Herbert Freudenberger (Freudenberger, 1974).

Over time, different scales and inventories have been developed to capture the dimensions of the phenomenon, being used both in academic research and in organizational practice. A synthesis of these tools was also carried out by specialized institutions (Eurofound, 2018), highlighting the importance of standardizing the assessment of burnout.

The most widely used instrument internationally is the Maslach Burnout Inventory (MBI), developed by Christina Maslach and Susan Jackson in 1981. This instrument measures the three fundamental dimensions of burnout: emotional exhaustion, depersonalization, and diminished personal accomplishment. Its popularity is due to its validity and broad applicability across various professional fields. However, its proprietary nature entails certain costs, which may limit its accessibility for early-career researchers.

An important alternative is the Oldenburg Burnout Inventory (OLBI), developed by Evangelia Demerouti and Arnold Bakker. This instrument conceptualizes burnout in two main dimensions: exhaustion and disengagement from work, and is directly correlated with the job demands–resources (JD-R) model. The OLBI is appreciated for its flexibility and for including both positively and negatively worded items. Another relevant instrument is the Copenhagen Burnout Inventory (CBI), developed by Tage Kristensen and his collaborators. It proposes an approach focused exclusively on the dimension of exhaustion, considered the core of the phenomenon, and distinguishes between personal, professional and relationship-related exhaustion. The CBI is frequently used in the public sector and in international comparative studies.

In another approach, the Shirom-Melamed Burnout Measure (SMBM), developed by Arie Shirom and Samuel Melamed, defines burnout in terms of three components: physical exhaustion, cognitive fatigue, and emotional exhaustion. This perspective emphasizes the energetic dimension of burnout and has been used mainly in research in Northern Europe.

More recently, Gordon Parker and colleagues developed the Sydney Burnout Measure (SBM), a complex instrument that extends the analysis of burnout by including additional dimensions, such as cognitive impairment, loss of empathy, social withdrawal, and decreased professional performance, along with symptoms associated with anxiety and depression.

In conclusion, the diversity of burnout assessment instruments reflects the plurality of theoretical perspectives on the phenomenon. The choice of an appropriate instrument depends on the purpose of the research, the organizational context, and the dimensions targeted, being essential for obtaining valid and relevant results in the analysis of professional burnout.

Causes and determinants of burnout

Burnout syndrome is a complex state of physical, emotional and cognitive exhaustion, characterized by impaired affective functioning and cognitive processes, depersonalization, cynicism, detachment and diminished sense of personal efficacy and accomplishment. Affected individuals experience a significant decrease in motivation and energy levels (Maslach & Leiter, 2016).

The World Health Organization recognizes burnout as an occupational phenomenon associated with chronic workplace stress that has not been effectively managed. It is correlated with increased risks for various conditions, including hypertension, cardiovascular disorders (such as atrial flutter), depression and suicidal behaviors (WHO, 2019; Salvagioni et al., 2017).

Initially, the concept of burnout was predominantly associated with professions in fields with high exposure to emotional stress (e.g., medical personnel, police officers, firefighters), but recent research indicates an extension of the phenomenon to multiple occupational categories and even in non-professional contexts, including among children and their caregivers. The specialized literature highlights a higher prevalence of burnout among physicians compared to other professional categories, even after controlling for variables such as education level and workload. The consequences include increased staff turnover, decreased quality of medical care, deterioration of interpersonal relationships, and an increased risk of problematic alcohol consumption (Shanafelt et al., 2015).

Burnout is a multifactorial phenomenon, determined by the interaction between individual characteristics, interpersonal relationships and the organizational context. There is a mistaken tendency to attribute responsibility exclusively to the individual, but many determining factors are external and often beyond personal control (Maslach & Leiter, 2016).

Three main types of burnout are described in the literature:

1. **Individual burnout** – associated with traits such as perfectionism, neuroticism, and a persistent negative self-talk, which leads to unrealistically high standards or a constant perception of inadequacy (Hill & Curran, 2016).
2. **Interpersonal burnout** – caused by conflicting or dysfunctional relationships at work or in the family environment, including interactions with hostile superiors or colleagues (Leiter & Maslach, 2009).
3. **Organizational burnout** – the result of deficient organizational structures, excessive demands, and unrealistic deadlines, which lead to overwork and professional insecurity (Bakker & Demerouti, 2017).

Occupational factors that trigger burnout

Factors specific to the professional environment include:

- role and responsibilities ambiguity;
- time pressures and unrealistic deadlines;
- excessive workload and difficult tasks to manage;
- lack of effective time management skills or practices (including the negative effects of multitasking on productivity);
- lack of managerial support and poor communication;
- rude or hostile behaviors of colleagues and superiors;
- perception of organizational inequity (e.g., lack of recognition of merit);
- excessive collaboration and loss of control over tasks;
- blurring of boundaries between professional and personal life (Kossek et al., 2012; Gallup, 2020).

Overall, burnout should be understood as the result of a dynamic interaction between the individual and his or her environment, requiring interventions at both the personal and organizational levels.

Burnout symptoms

Burnout syndrome manifests itself through a set of multidimensional symptoms, in which the classic triad – emotional exhaustion, detachment (or cynicism) and decreased personal efficacy – constitutes the clinical core, although these elements are not always easily recognized through self-assessment (Maslach & Leiter, 2016).

Clinical and psychological manifestations

Mental and physical exhaustion is one of the most common manifestations. It is characterized by persistent fatigue, lack of energy upon waking, and difficulty initiating and maintaining daily activities. The literature indicates a significant overlap between the symptoms of burnout and those of depression, with studies suggesting that approximately 20-50% of people with burnout present with significant depressive symptoms (Bianchi et al., 2015). In chronic forms, exhaustion can become somatized, manifesting itself through headaches, gastrointestinal disorders, or increased susceptibility to infections (Salvagioni et al., 2017).

The dimension of detachment and cynicism involves a persistent negative attitude towards work and interpersonal relationships. This can translate into increased pessimism, distrust of colleagues, and a tendency toward social isolation. According to Gallup studies, employees who report high levels of burnout are 2.6 times more likely to exhibit cynicism and disengagement from their professional activities (Gallup, 2020).

Decreased professional or academic performance is a direct consequence of impairment of executive functions, especially in the prefrontal cortex, responsible for planning, decision-making and attention control. Chronic stress causes dysfunction in these circuits, leading to frequent errors, reduced productivity and difficulty solving complex tasks.

Cognitive and motivational disorders

Burnout is associated with concentration deficits, decreased working memory, and organizational difficulties. Studies show that up to 35% of affected employees report significant cognitive problems, including frequent forgetfulness and the inability to maintain attention for long periods of time (Deligkaris et al., 2014).

Lack of motivation and reduced involvement are common, being correlated with a decreased sense of self-efficacy. In parallel, the phenomenon of “obsessive work” may occur, characterized by the prolongation of professional activities outside the schedule, to the detriment of psychophysiological recovery. This tendency is associated with an increased risk of worsening symptoms and the onset of chronic exhaustion (Schaufeli et al., 2009).

Emotional and behavioral disorders

From an affective point of view, burnout is manifested by irritability, frustration, persistent feelings of devaluation and pessimism. Unlike transient emotional reactions, these states become dominant and generalized. Approximately 60% of people with burnout report increased levels of irritability and emotional instability (Ahola et al., 2010).

Interpersonal problems are common, including increased conflict, decreased tolerance and a tendency to social avoidance. These difficulties affect both the professional environment and family relationships.

Lifestyle changes are also observed, including neglecting personal care and adopting unhealthy behaviors. Studies indicate that people with burnout have a 1.5-2 times higher risk of problematic use of alcohol and other substances (Salvagioni et al., 2017).

Sleep and physical health disorders

Sleep disorders, such as insomnia or sleep fragmentation, are reported by over 40% of individuals affected by burnout (Eurofound, 2018). They contribute to worsening exhaustion and impaired cognitive functioning.

In the long term, chronic stress associated with burnout can lead to significant somatic conditions, including cardiovascular disease, diabetes, digestive disorders and obesity. Meta-analyses suggest that burnout increases the risk of cardiovascular disease by approximately 21% (Kivimaki et al., 2012).

Decreased overall satisfaction

Another relevant aspect is the decrease in overall satisfaction with life and work. This manifests itself in feelings of uselessness, lack of personal accomplishment, and a perception of stagnation. According to research, employees with burnout are twice as likely to report severe job dissatisfaction compared to those without symptoms (Maslach & Leiter, 2016).

Organizational Consequences

Burnout syndrome has significant consequences at the organizational level, affecting performance, human resource stability and the quality of services provided. The specialized literature highlights the fact that burnout is not just an individual problem, but a systemic risk for the efficient functioning of organizations (Maslach & Leiter, 2016).

Impact on organizational performance

Burnout is associated with decreased productivity and work efficiency. Affected employees exhibit reduced levels of engagement and concentration, which leads to increased errors and decreased quality of results. Studies show that employees with high levels of burnout are up to 63% more likely to take frequent sick leave and 23% more likely to report performance declines (Gallup, 2020).

Also, impairment of executive functions, correlated with dysfunctions in the prefrontal cortex, contributes to difficulties in decision-making and solving complex problems, with a direct impact on organizational results.

Employee turnover and associated costs

One of the most important effects of burnout is increased employee turnover. Burnout employees are 2.6 times more likely to look for a new job (Gallup, 2020). This dynamic generates significant additional costs for organizations, including the costs of recruiting, selecting, and training new employees.

In addition, absenteeism and presenteeism (presence at work under low-efficiency conditions) contribute to considerable economic losses. Estimates indicate that presenteeism can have an even greater financial impact than absenteeism, by reducing overall productivity (Hemp, 2004).

Deterioration of organizational climate

Burnout negatively influences interpersonal relationships and organizational climate. Affected employees frequently display cynicism, irritability, and a tendency to isolate themselves, which can generate conflicts and reduce team cohesion. These dynamics affect collaboration and communication, essential elements for the efficient functioning of organizations.

A deteriorated organizational climate is associated with reduced levels of job satisfaction and organizational commitment, which increases the risk of collective disengagement.

Decreased service quality and customer satisfaction

Burnout has a direct impact on the quality of services provided, especially in areas such as health, education or social services. In the case of health professionals, for example, burnout is associated with increased medical errors and decreased patient satisfaction (Shanafelt et al., 2015).

This deterioration in service quality can affect the organization's reputation and lead to a loss of trust from beneficiaries or customers.

Organizational and economic risks

In the long term, burnout contributes to increased organizational costs by:

- reducing overall performance;
- increasing medical costs and health benefits;
- decreasing innovation and adaptability;
- loss of human and intellectual capital.

Organizations with high levels of burnout among employees are less resilient and more vulnerable to changes in the economic environment (Bakker & Demerouti, 2017).

The strategic role of human resource management in managing burnout

Managing organizational burnout represents a major strategic challenge for human resource management (HRM), with direct implications for the performance, sustainability and competitiveness of the organization. Contemporary approaches emphasize the need for systemic interventions, focused not only on the individual, but also on the organizational environment and managerial practices.

HRM has an essential role in preventing and reducing burnout by developing organizational policies that balance job demands with available resources. According to the Job Demands–Resources model, burnout occurs when professional demands exceed employees' ability to manage them in the absence of adequate resources (Bakker & Demerouti, 2017). In this context, HRM must act as a mediator between organizational objectives and employee well-being.

Job Design and Redesign

One of the main implications of HRM is optimizing job design. This involves clarifying roles, reducing ambiguity, and adjusting workload to employees' actual capabilities. Studies show that role ambiguity and overload are significant predictors of burnout (Maslach & Leiter, 2016).

Job redesign can include introducing decision-making autonomy, making tasks more flexible, and diversifying activities, which helps increase motivation and reduce burnout.

Leadership Development and Managerial Support

The quality of leadership is a determining factor in preventing burnout. Managers who provide emotional and professional support significantly reduce the risk of burnout among employees. According to Gallup data, employees who feel supported by their superiors are up to 70% less likely to experience burnout (Gallup, 2020).

HRM must implement training programs for leaders, focused on developing communication skills, empathy, stress management, and performance recognition.

Promoting work-life balance

Another key area of intervention is facilitating work-life balance. Flexible work schedules, teleworking, and limiting workload overload all contribute to reducing chronic stress. Research indicates that a lack of work-life balance is a major predictor of burnout (Kossek et al., 2012).

HRM has a responsibility to create an organizational culture that encourages disconnection and psychological recovery.

Fair Evaluation and Reward Systems

Perceptions of organizational inequity are associated with increased levels of cynicism and disengagement. Therefore, HRM must ensure transparency and fairness in performance evaluation, promotion, and reward processes. Lack of recognition is identified as a major risk factor for burnout (Maslach & Leiter, 2016).

Implementing constructive feedback and recognition systems helps strengthen organizational commitment.

Occupational health interventions

HRM should integrate occupational health programs that include:

- periodic assessment of stress and burnout levels;
- psychological counseling services;
- resilience and coping development programs;
- stress management training.

These interventions contribute to reducing absenteeism and improving the overall health of employees (Salvagioni et al., 2017).

Monitoring and using organizational data

A modern approach involves using HR analytics to identify burnout risks early. Indicators such as staff turnover, absenteeism, or decreased performance can signal systemic problems. HR can use this data to develop targeted interventions and evaluate the effectiveness of implemented policies.

Organizational Culture and Long-Term Prevention

Ultimately, HRM plays a central role in shaping organizational culture. Promoting a climate based on trust, respect, and collaboration significantly reduces the risk of burnout. Organizations that prioritize employee well-being demonstrate higher levels of performance and retention (Bakker & Demerouti, 2017).

5. Conclusions

The analysis of burnout in relation to organizational effectiveness highlights that this phenomenon represents a systemic problem, with a direct impact on individual performance, team dynamics and overall organizational results. Burnout should not be understood exclusively as a consequence of individual vulnerabilities, but as the result of the complex interaction between occupational demands, available resources and managerial practices.

From the perspective of organizational effectiveness, burnout contributes to decreased productivity, increased errors, diminished professional commitment and increased staff turnover. These effects generate significant direct and indirect costs, affecting the competitiveness and sustainability of organizations in the long term.

The results of the specialized literature emphasize that the prevention and management of burnout cannot be effectively achieved through exclusively individual interventions, but requires an integrated approach, oriented towards the organizational structure and culture. In this sense, human resource management has an essential role in designing balanced work systems, in developing supportive leadership and in implementing coherent occupational health policies. At the same time, the balance between job requirements and organizational resources, role clarity, performance recognition and support for work-life balance emerge as determining factors in reducing the risk of burnout and increasing organizational efficiency. Organizations that invest in employee well-being demonstrate higher levels of involvement, retention and sustainable performance.

In conclusion, burnout must be addressed as a critical indicator of organizational dysfunction, and human resource management has a strategic responsibility to transform its prevention into an organizational priority. A proactive approach, based on scientific evidence and systemic interventions, can significantly contribute to increasing organizational efficiency and developing a healthy and sustainable work environment.

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INNOVATION-DRIVEN POLICIES AND STRATEGIC MECHANISMS FOR SUSTAINABLE EXPORT GROWTH OF THE REPUBLIC OF MOLDOVA IN THE PROCESS OF EUROPEAN INTEGRATION

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Abstract: *This paper examines the role of innovation-driven policies and strategic mechanisms in ensuring sustainable export growth of the Republic of Moldova in the context of European Integration. The objective is to assess whether export growth is supported by structural competitiveness factors or remains dependent on external demand conditions. The study applies a mixed-method approach combining quantitative analysis of export dynamics with qualitative evaluation of policy frameworks. A comparative perspective is employed, analyzing Moldova alongside Estonia, Lithuania, Romania and Georgia, using indicators related to export performance, innovation capacity and economic complexity. The results indicate that although Republic of Moldova experienced export expansion following the implementation of the DCFTA Agreement, this growth remains structurally fragile. Export performance is characterized by volatility, limited diversification and low technological intensity. In contrast, countries with stronger innovation systems demonstrate more stable and resilient export trajectories, supported by higher export complexity and integration into global value chains. The paper contributes to the literature by integrating export dynamics, innovation performance and policy analysis within a unified framework applied to a small open economy. The findings highlight the importance of strengthening innovation capacity and policy coherence to support sustainable export growth and enhance long-term economic resilience.*

Keywords: *innovation-driven policies, export competitiveness, sustainable export growth, structural transformation, European integration, Republic of Moldova.*

Classification JEL: F14, O31, O47.

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1. Introduction

Sustainability has become a central objective of modern economic development strategies and programs. In the context of globalization, economic resilience and sustainable growth increasingly depend on the ability of countries to strengthen their export performance while maintaining long term competitiveness. For small open economies, exports represent a key driver of economic growth, structural transformation and integration into global value chains (European Commission, 2017).

In recent years, the concept of sustainable export growth has gained increasing attention in economic research and policy debates. Sustainable export growth refers not only to the expansion of export volumes but also to the capacity of economies to maintain long term competitiveness through innovation, technological upgrading and effective economic policies (Ji et al, 2022).

Innovation plays a crucial role in this process, as it enhances productivity, supports the diversification of export structures and enables firms to adapt to rapidly changing global markets, as demonstrated by Hsu et al. (2019) and Filatotchev et al. (2009). According to Aghion and Howitt (1998), innovation is a fundamental driver of productivity and long term economic growth, as it supports structural transformation and enhances the capacity of

economies to remain competitive in international markets. Empirical evidence provided by Hsu et al. (2019) and Filatotchev et al. (2009) shows that innovation and export activities are mutually reinforcing, as firms engaged in international markets benefit from knowledge spillovers that enhance their innovation capacity, while innovation increases their competitiveness in export markets.

For the Republic of Moldova, the issue of export sustainability is particularly relevant in the context of its European Integration process and the need to strengthen economic resilience and competitiveness. Despite significant progress in expanding trade relations and accessing external markets, Moldova exports remain characterized by structural vulnerabilities, including a relatively limited diversification of products and markets, as well as a modest level of technological intensity (European Commission, 2025).

In this context, the research problem addressed in this paper concerns the role of policy mechanisms and innovation in ensuring the sustainability of export growth. Understanding how strategic economic policies and innovation systems contribute to strengthening export competitiveness is essential for designing effective development strategies.

The objective of this study is to analyze the role of innovation as a driver of sustainable export growth and to examine the policy mechanisms that can support this process, with particular reference to the Republic of Moldova. The research explores how innovation capacity, together with appropriate economic policies, can enhance export competitiveness and support long term economic resilience.

Methodologically, the study relies on qualitative analysis of economic policies, conceptual analysis of sustainability and innovation in international trade, and structural assessment of export dynamics. The findings contribute to the broader academic and policy discussion on sustainable economic development and export competitiveness in the context of global systemic transformations.

2. Literature Review

The concept of sustainable export growth has been widely discussed in the economic literature, particularly in the context of globalization and structural transformation. Traditional trade theories, including comparative advantage (Ricardo) and factor endowment theory (Heckscher-Ohlin), explain export performance based on resource availability and cost advantages (OECD, 2015). However, more recent approaches emphasize the role of innovation, technological capabilities and institutional quality as key determinants of long-term competitiveness.

Endogenous growth theory provides an important theoretical foundation for understanding the relationship between innovation and export performance. According to Romer (1990) and Grossman and Helpman (1991), technological progress and knowledge accumulation are central drivers of productivity and economic growth (Dieppe, 2021). In this framework, innovation enhances firms' ability to compete in international markets by improving product quality, reducing costs and enabling diversification. Empirical studies confirm that countries with higher innovation capacity tend to exhibit more sophisticated export structures and greater resilience to external shocks.

The literature on export competitiveness increasingly highlights the importance of export complexity and diversification. Thus, the structure of exports plays a crucial role in

determining economic growth, as not all goods contribute equally to productivity and development. Hausmann, Hwang and Rodrik (2005) argue that countries specializing in higher productivity goods tend to achieve faster economic growth, as these products embody higher levels of knowledge, technology and value added. Their analysis shows that the composition of exports can predict future growth, highlighting the importance of moving toward more sophisticated export structures. The Economic Complexity Index (ECI) has been widely used to assess the knowledge intensity embedded in export structures (OECD, 2025). Studies show that economies with higher ECI values are better integrated into global value chains and demonstrate stronger long-term growth performance.

Another important strand of literature focuses on the relationship between innovation systems and trade performance. The concept of National Innovation Systems, developed by (Fagerberg et al., 2011) and grounded in the foundational contributions of Freeman (1987) and Lundvall (1992), emphasizes that innovation emerges from interactive processes between firms, research institutions and public authorities. In this framework, learning, knowledge accumulation and institutional structures play a central role in shaping economic performance and international competitiveness (Lundvall, 2007).

From this perspective, policy coherence and institutional capacity are essential for transforming innovation into export competitiveness. National innovation systems operate through coordinated interactions between economic structure and institutions, where the effectiveness of policies depends on their alignment with national capabilities and learning processes (Lundvall, 2007). Empirical and policy-oriented studies, including those developed under the OECD framework, show that countries with well-integrated innovation policies in research, industrial development and technological upgrading tend to achieve stronger export performance, especially in knowledge-intensive and high value-added sectors (OECD, 1999; Nelson, 1993).

Recent studies also examine the role of policy frameworks in supporting sustainable export growth, especially in small open economies. Research on Central and Eastern European countries shows that access to external markets, such as the European Union, can stimulate export growth, but does not automatically lead to structural transformation. According to the World Bank (2025), while trade integration supports economic expansion, it does not guarantee productivity gains or diversification without strong domestic capabilities.

Without sufficient investment in innovation, technological upgrading and institutional quality, export growth remains vulnerable to external shocks and tends to be concentrated in low value-added sectors (Dieppe, 2021; OECD, 2015). These findings suggest that sustainable export performance depends not only on market access, but also on the development of national innovation systems and the capacity to absorb and generate knowledge.

In the case of the Republic of Moldova, existing studies primarily focus on trade liberalization, export potential and sectoral competitiveness. The implementation of the Deep and Comprehensive Free Trade Area (DCFTA) has been widely analyzed as a key driver of export expansion and market reorientation towards the European Union. However, the literature also highlights persistent structural challenges, including limited diversification, low technological intensity and weak integration into global value chains.

Empirical evidence shows that Moldovan exports remain concentrated in a relatively narrow range of products, with a strong focus on agri-food goods and labor-intensive industries, and only gradual progress in improving export quality and complexity (International Monetary

Fund, 2026). These findings indicate that, despite improved access to external markets, the structural transformation of exports remains constrained by limited diversification and insufficient technological upgrading.

Despite these contributions, several gaps remain in the literature. First, there is limited integration between the analysis of innovation performance and export sustainability in the context of Moldova. Most studies treat these dimensions separately, without examining their interaction. Second, there is a lack of comparative analysis that positions Moldova alongside countries with different levels of innovation and export complexity. Third, insufficient attention is given to the role of policy coherence and institutional mechanisms in linking innovation systems with export performance.

This study addresses these gaps by integrating the analysis of export dynamics, innovation performance and policy frameworks within a unified analytical approach. By combining comparative analysis, international rankings and policy evaluation, the research contributes to a better understanding of the mechanisms through which innovation-driven policies can support sustainable export growth in small open economies, with particular reference to the Republic of Moldova.

3. Methodology

This study applies a mixed-method research design combining quantitative analysis of export performance with qualitative assessment of policy frameworks. The approach allows for an integrated examination of the relationship between export dynamics, innovation capacity and policy mechanisms.

The research follows a comparative analytical framework, focusing on the Republic of Moldova in relation to selected benchmark countries, namely Estonia, Lithuania, Romania and Georgia. These countries were selected based on their relevance in terms of regional context and varying levels of innovation performance and export complexity. The analysis covers the period 2014-2025, capturing key developments following the implementation of the Deep and Comprehensive Free Trade Area and the recent EU candidate status.

The study relies on secondary data obtained from national and international sources, including the National Bureau of Statistics of the Republic of Moldova, Eurostat, UN Comtrade and international reports. The main indicators used in the analysis include export values and structure, exports as a share of GDP, the Global Innovation Index and the Economic Complexity Index. In parallel, national policy documents and strategic frameworks related to innovation, digitalization and economic development were examined.

The analytical approach combines descriptive statistical analysis of export trends with comparative assessment across countries. Structural analysis is applied to evaluate the technological intensity and diversification of exports, while indicator-based analysis is used to assess competitiveness and innovation capacity. In addition, a qualitative policy analysis is conducted to examine the coherence and effectiveness of national strategies in supporting export performance.

The selected methodology ensures comparability and allows for the identification of structural patterns linking innovation, policy frameworks and export sustainability.

However, the study is limited by the use of aggregated data and partial availability of recent statistics for 2025. Despite these constraints, the approach provides a consistent basis for assessing the determinants of sustainable export growth.

4. Results and Discussion

Export trends and comparative trade performance. In recent years, the evolution of export performance in the Republic of Moldova reflects both progress in market integration and persistent structural vulnerabilities. Between 2014 and 2022, Moldova's exports increased significantly, from approximately 2.34 billion USD to around 4.0 billion USD, driven largely by the implementation of the Deep and Comprehensive Free Trade Area (DCFTA) and improved access to the European Union market. However, starting from 2023, export dynamics became unstable. Exports declined by 9.0 percent in 2023 and further decreased by 12.3 percent in 2024, reaching approximately 3.55 billion USD. Preliminary data for 2025 indicate only a modest recovery, with an estimated increase of about 1.6 percent, corresponding to a total export value of approximately 3.6–3.65 billion USD.

This pattern suggests a stabilization rather than a strong recovery and confirms the fragility of export growth. At the same time, the geographical structure of exports has undergone a significant transformation. The share of exports to the European Union increased steadily from 63.0 percent in 2020 to approximately 68.0 percent in 2025, while the share of CIS countries declined sharply from 15.0 percent to around 6.5 percent. The share of other countries remained relatively stable, with a slight increase over the period. This reorientation reflects Moldova's ongoing economic integration into the European market but does not eliminate structural constraints related to low export complexity and limited technological intensity. Overall, the data confirm that export growth in Moldova remains volatile and insufficiently supported by internal competitiveness factors, highlighting the need for innovation-driven structural transformation. Also, these trends suggest that existing policy frameworks have not generated sufficient structural transformation to sustain export growth.

Table 1. Export dynamics and geographical structure of Moldova's exports (2020–2025, %)

Year	Total exports (bn USD)	YoY	EU share	CIS share	Other countries
2020	2.50	–13.0	63.0	15.0	22.0
2021	3.15	+23.6	62.5	14.0	23.5
2022	4.00	+54.1	64.0	12.0	24.0
2023	4.05	–9.0	65.4	9.0	25.6
2024	3.55	–12.3	67.3	6.8	25.9
2025*	~3.60–3.65 (est.)	+1.6	~68.0	~6.5	~25.5

Source. Author's elaboration based on BNS Moldova (*StatBank*).

To ensure a meaningful comparative framework, further the analysis focuses on a set of countries selected based on their relevance to the Republic of Moldova in terms of economic structure, development trajectory, and integration into international markets. Georgia is included as a structurally comparable economy with a similar initial export level, allowing for the assessment of alternative development paths. Estonia and Lithuania represent small open economies that have successfully leveraged innovation and European integration to

achieve stable and sustainable export growth. Romania is considered a regional benchmark, reflecting a larger economy with strong industrial capabilities and deep integration into European value chains.

In this vein, the comparative analysis of export performance over the period 2014–2024 reveals significant differences in both the scale and sustainability of export growth across the selected countries.

At the initial stage of the DCFTA implementation in 2014, the Republic of Moldova recorded exports of approximately 2.34 billion USD, a level comparable to Georgia, which reported exports of around 2.86 billion USD. In contrast, EU member states already demonstrated substantially higher export capacities, with Estonia reaching 17.47 billion USD, Lithuania 32.39 billion USD, and Romania nearly 69.88 billion USD. This initial gap reflects differences in industrial structure, productivity, and integration into international markets.

Over the following decade, all countries experienced export growth, but with markedly different trajectories. By 2024, Moldova's exports increased to approximately 3.56 billion USD, representing a cumulative growth of around 52 percent. However, this expansion remains modest both in absolute and relative terms. In comparison, Georgia achieved a significantly higher growth rate of approximately 129 percent, reaching 6.56 billion USD in 2024. This suggests a stronger capacity for export expansion and adaptation to external market conditions.

At the same time, Estonia and Lithuania maintained relatively stable export performance, with moderate but consistent growth. Estonia's exports increased to approximately 19.77 billion USD, while Lithuania reached around 39.82 billion USD in 2024. Romania demonstrated the strongest absolute performance, exceeding 100 billion USD in exports, supported by its integration into European industrial value chains and sustained inflows of foreign direct investment.

The comparative evidence highlights not only differences in growth rates but also in the stability and resilience of export performance. Moldova's export trajectory is characterized by higher volatility, with fluctuations observed particularly after 2022. This contrasts with the more stable patterns observed in EU member states, where export performance reflects stronger internal drivers such as innovation capacity, industrial diversification, and higher technological intensity.

These differences suggest that export growth in Moldova has been driven primarily by external factors, including market access and demand conditions, rather than by structural improvements in competitiveness. The relatively limited diversification of exports and lower levels of technological sophistication constrain the country's ability to sustain long-term growth. At the same time, cross-country differences point to the role of innovation capacity and industrial policy effectiveness in shaping more resilient and sustainable export trajectories.

In contrast, countries with stronger innovation systems and more advanced economic structures demonstrate not only higher export volumes but also greater resilience to external shocks. This confirms that innovation, productivity, and structural transformation are critical determinants of sustainable export growth, rather than export expansion alone.

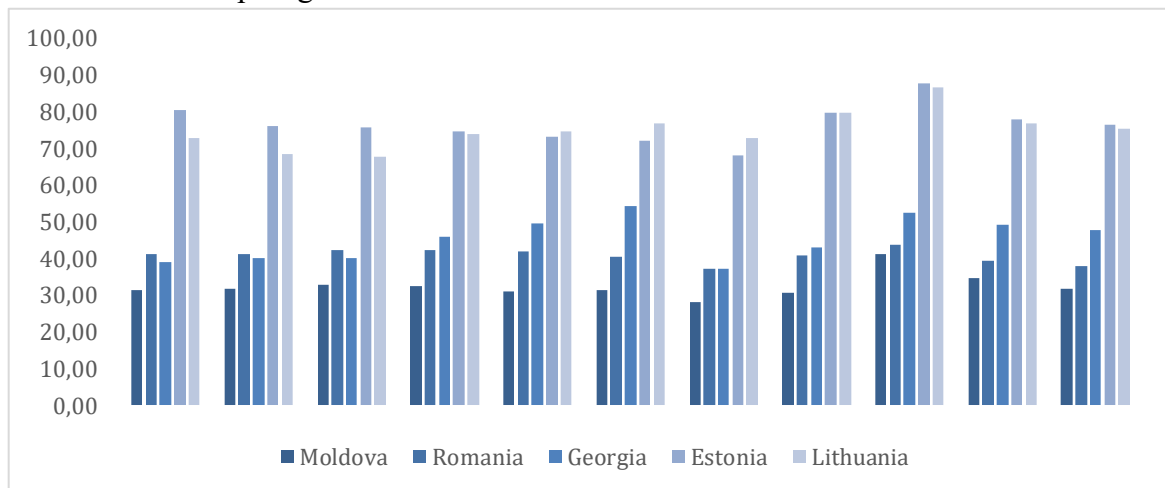
Table 2. Comparative export performance of selected countries (2014–2024, USD billion)

	2014	2020	2021	2022	2023	2024	Growth 2014–2024 (%)
Republic of Moldova	2.34	2.47	3.14	4.33	4.05	3.56	+52%
Estonia	17.47	16.90	22.30	23.60	20.11	19.77	+13%
Lithuania	32.39	32.79	40.70	46.50	42.63	39.82	+23%
Romania	69.88	71.05	88.39	96.83	100.64	100.37	+44%
Georgia	2.86	3.34	4.24	5.58	6.09	6.56	+129%

Source: Author's calculations based on UN Comtrade Database, available at: <https://comtrade.un.org/>

An additional perspective on export performance is provided by the share of exports in GDP, which reflects the degree of economic openness and dependence on external markets. As illustrated in Figure below, the Republic of Moldova maintains a relatively low export-to-GDP ratio compared to peer economies, fluctuating between approximately 28 percent and 41 percent over the period 2014-2024. In contrast, Estonia and Lithuania demonstrate significantly higher levels of export intensity, consistently exceeding 70 percent of GDP. This indicates a strong integration into international markets and a higher capacity to sustain export-led growth. Romania exhibits a moderate but stable level, around 38-43 percent, reflecting its balanced economic structure and diversified industrial base. Georgia shows a more volatile but generally increasing trend, reaching over 50 percent in peak years, suggesting a growing reliance on external demand.

The comparison highlights that Moldova's export sector remains relatively underdeveloped in terms of its contribution to the overall economy. Moreover, fluctuations in the export-to-GDP ratio suggest vulnerability to external shocks and limited capacity to maintain stable export growth.

**Figure 1. Exports of goods and services (% of GDP), selected countries (2014–2024)**

Source: World Bank, World Development Indicators (<https://data.worldbank.org/indicator/NE.EXP.GNFS.ZS>)

When combined with the previous analysis of export volumes, these findings reinforce the conclusion that Moldova's export performance is constrained not only by scale but also by structural factors. In economies such as Estonia and Lithuania, high export intensity is supported by innovation, productivity, and integration into value chains. In contrast,

Moldova's lower export share reflects weaker structural foundations and limited transformation of the domestic economy toward export-oriented sectors.

From a structural perspective, Moldovan exports remain concentrated in low and medium value added sectors, including agri food products, textiles and basic manufacturing. The share of high technology exports remains limited, typically below 5 percent of total exports. By contrast, Estonia and Lithuania have significantly higher shares of medium and high technology exports, supported by strong innovation ecosystems and industrial policies.

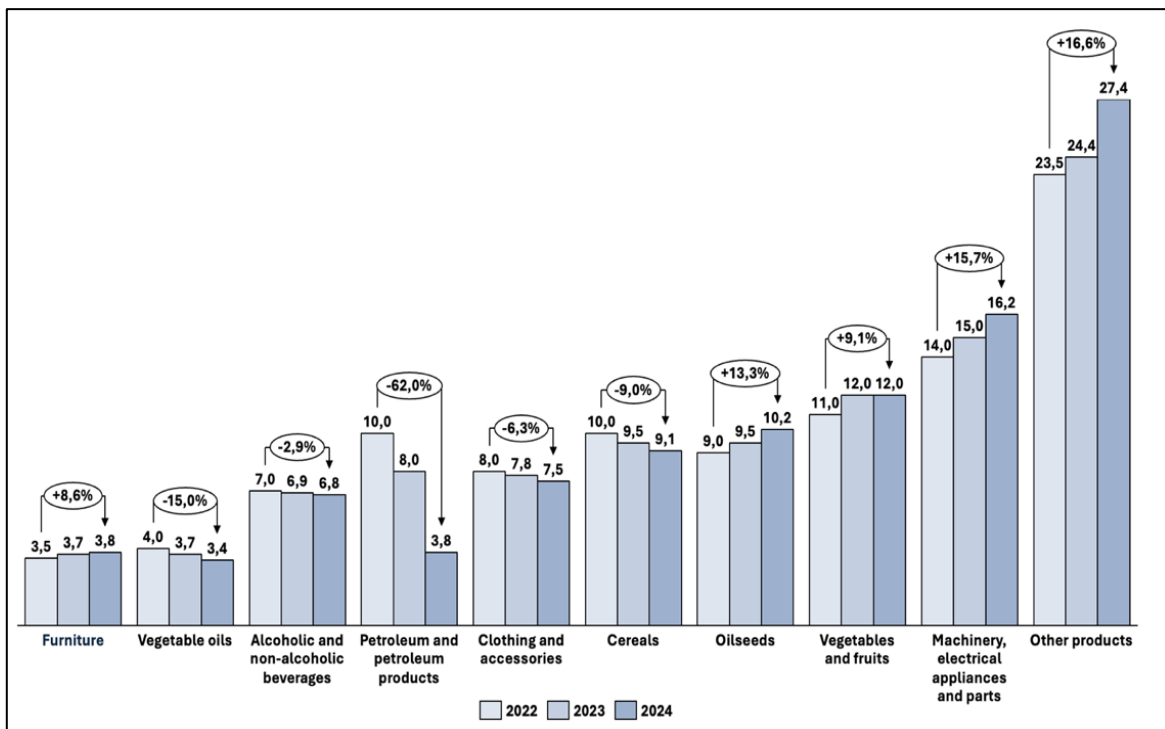


Figure 2. Structural composition of Moldova's exports by main product groups, % from total exports (2022–2024)

Source: National Bureau of Statistics, 2025, author's calculations

These findings suggest that while Moldova has achieved quantitative export growth, it has not yet achieved qualitative transformation. The lack of diversification and low technological intensity reduce the capacity of exports to remain stable in the face of external shocks.

International competitiveness rankings and innovation performance. The analysis of international rankings further confirms the structural limitations of Moldova's export competitiveness. According to the Global Innovation Index, Moldova has experienced a significant decline in recent years, falling from around 44th position in 2015 to approximately 74th position in 2025. This represents a loss of around 30 positions and indicates a weakening of the country's innovation capacity. In contrast, Estonia improved its position from 23rd to around 16th place, while Lithuania advanced to approximately 33rd position. Romania maintained a relatively stable position around 49th place, while Georgia improved significantly, moving closer to the group of emerging innovators.

A similar pattern is observed in the Economic Complexity Index. Moldova records a negative score of approximately -0.7, indicating a low level of export sophistication and a concentration in products with limited knowledge content. Estonia and Lithuania, by

contrast, have positive scores above 1.0, reflecting advanced export structures and strong technological capabilities.

Table 3. Comparative dynamics of innovation and export sophistication (2015–2025)

Country	GII Rank 2015	GII Rank 2021	GII Rank 2025	Change 2015–2025	ECI Rank (latest)	Structural Profile
Estonia	23	21	16	+7	~28	High innovation, high export sophistication
Lithuania	38	39	33	+5	~29	Converging innovation, strong industrial base
Romania	54	48	49	+5	~23	Moderate innovation, strong industrial integration
Georgia	73	63	56	+17	~63	Improving innovation, low export sophistication
Moldova	44	64	74	-30	~71	Declining innovation, low export sophistication

Source: Author's compilation based on Global Innovation Index (WIPO) and Atlas of Economic Complexity data.

These rankings highlight a clear divergence between Moldova and more advanced economies. While Moldova has improved its market access, it has not succeeded in upgrading its productive structure or innovation system at a comparable pace.

The gap in innovation performance directly affects export competitiveness. Countries with higher innovation capacity are better able to diversify their exports, move towards higher value added sectors and maintain stable growth over time. Moldova's declining position in international rankings suggests that its export growth is not supported by strong internal drivers.

Policy framework, strategic mechanisms and institutional priorities. The policy framework of the Republic of Moldova reflects a clear recognition of the importance of innovation, digitalization and sustainable development. Several strategic documents outline ambitious objectives for enhancing competitiveness and supporting export growth.

The “Moldova European 2030” strategy sets the overall vision for economic development, emphasizing sustainable growth, integration into the European Union and the development of a competitive economy. Export growth is seen as a key pillar of this strategy.

The Digital Transformation Strategy for 2023-2030 aims to increase the contribution of the ICT sector to over 10 percent of GDP and to accelerate the digitalization of businesses. Targets include increasing the share of companies using digital technologies and expanding online commercial activities.

In the field of research and innovation, the National Programme for Research and Development seeks to strengthen the national innovation system and promote participation in European research initiatives such as Horizon Europe. The objective is to increase the commercialization of research results and improve collaboration between academia and industry.

Industrial policies focus on supporting small and medium sized enterprises, improving productivity and facilitating access to international markets. At the same time, green transition policies aim to align the economy with European environmental standards, although they also introduce additional cost pressures for producers.

Despite this comprehensive policy framework, a key challenge remains the limited coherence between different policy areas. Innovation, industrial development, digitalization and export promotion are often implemented as separate policy domains, reducing their overall impact. As a result, the transmission of policy measures into tangible export performance remains weak. The gap between strategic objectives and actual outcomes continues to limit the effectiveness of public interventions.

5. Conclusions

This study demonstrates that export growth in the Republic of Moldova, although significant over the last decade, remains structurally fragile and insufficiently supported by internal competitiveness factors. The decline in exports in 2025 confirms that the observed expansion was not driven by sustainable mechanisms, but rather by external conditions and improved market access.

The findings highlight a clear structural constraint: Moldova's export performance is not innovation-driven. The low level of technological intensity, negative export complexity and declining position in international innovation rankings indicate limited capacity for upgrading and diversification. In contrast, comparative analysis shows that countries with stronger innovation systems achieve more stable and resilient export growth.

A key contribution of this research lies in integrating export dynamics, innovation performance and policy frameworks into a unified analytical perspective. The results demonstrate that policy ambition alone is insufficient. Without effective transmission mechanisms linking innovation, industrial development and export promotion, strategic objectives do not translate into measurable economic outcomes.

From a practical perspective, the study emphasizes the need for a shift from volume-based export growth towards structure-driven competitiveness. Policy interventions should focus on linking innovation financing to export outcomes, supporting high value-added sectors, strengthening research-business collaboration and improving coordination across policy domains.

The findings are particularly relevant in the context of European integration, where compliance with standards and increased competition require higher levels of productivity and technological capability. Strengthening these dimensions is essential for ensuring long-term export sustainability and economic resilience.

Future research should extend the analysis to firm-level data in order to better understand microeconomic determinants of export performance and the effectiveness of specific policy instruments.

Ensuring sustainable export growth requires targeted and coordinated interventions that directly address the identified structural weaknesses:

1. innovation financing should be directly linked to export outcomes. Public support schemes for innovation need to include clear performance conditions, such as the development of export-oriented products or measurable increases in export revenues.

A dedicated instrument, such as export innovation vouchers for small and medium-sized enterprises, can accelerate this process;

2. policy efforts should focus on a limited number of high value-added sectors with export potential. Priority areas include advanced agro-processing, light manufacturing components, digital services and certified ecological products. Targeted state aid, cluster development and strategic partnerships with foreign investors can support the transition towards more complex export structures;
3. a national export readiness program is needed to support firms in accessing external markets. This should include support for certification according to European standards, participation in international trade fairs and assistance in entering new markets outside the European Union. Such measures will reduce market concentration and increase resilience;
4. stronger integration between research institutions and the business sector is essential. Public funding for research and development should prioritize projects developed in partnership with private companies. Fiscal incentives can encourage firms to invest in innovation, while functional technology transfer mechanisms can facilitate the commercialization of research results;
5. digitalization should be leveraged as a tool for expanding exports. Developing national platforms for digital exports, supporting firms in accessing global online marketplaces and digitalizing logistics processes can significantly improve market access and efficiency. Sixth, targeted support is required to help exporters adapt to green transition requirements. Financial mechanisms should compensate for compliance costs related to environmental standards, including energy efficiency investments and certification processes. This will prevent a loss of competitiveness during the transition;
6. improving institutional coordination is critical. Establishing a dedicated mechanism for aligning innovation, industrial, digital and export policies will increase the effectiveness of public interventions. This should be complemented by a monitoring system based on clear performance indicators, such as the share of high-tech exports, export diversification and the number of new exporting firms.

In addition, strengthening institutional coordination and policy coherence remains essential for ensuring sustainable export development. Fragmentation of support measures, limited alignment between industrial, innovation and trade policies, and insufficient monitoring mechanisms reduce the effectiveness of existing interventions. International experience shows that countries that achieve structural transformation successfully combine export promotion with targeted industrial policies, innovation support schemes and active integration into global value chains. For the Republic of Moldova, this implies the need to move beyond passive trade liberalization and adopt a more proactive strategic approach, focused on building competitive advantages in sectors with higher technological intensity and export potential.

These interventions can transform export growth from a quantitatively driven process into a structurally sustainable one, aligned with the objectives of European integration and long-term economic resilience.

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MULTIDIMENSIONAL ANALYSIS OF PROFESSIONAL AND TRANSVERSAL SKILLS IN THE ACADEMIC INSTITUTIONAL ENVIRONMENT

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Abstract: This study aims to conduct a multidimensional analysis of professional (hard) and transferable (soft) skills within the academic institutional environment, using a praxiological approach applied at the Academy of Economic Studies of Moldova (ASEM). In a context marked by profound digital transformations and increased volatility in the labor market, the study investigates faculty members' perceptions regarding the relevance, use, and methods of developing these skills, which are essential for a knowledge-based economy. The research methodology involved the use of a comprehensive questionnaire, structured into five thematic sections, which enabled the collection of both quantitative and qualitative data from a representative sample of faculty members. The investigation focused on identifying correlations between variables such as years of teaching experience, academic rank, and the degree of digitization of the educational process. The results highlight the central role of digital literacy and effective communication as pillars of contemporary pedagogical success, while also pointing to a discrepancy between the recognition of the importance of soft skills (empathy, adaptability, teamwork) and the formal opportunities available for developing them. The study highlights the need for a strategic approach to the continuing education of academic staff, moving beyond the traditional model of self-directed learning. The conclusions offer pragmatic recommendations for optimizing institutional strategies, proposing the creation of centers for pedagogical development and the institutionalization of programs dedicated to cross-cutting competencies. This integrated approach is fundamental for aligning the educational process with European standards and for strengthening the institution's prestige in the face of the dynamic demands of today's socio-economic environment.

Keywords: soft skills, hard skills, transferable skills, praxiological study, professional development, knowledge-based economy.

Classification JEL: I23, I25, M19, M53.

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1. Introduction

In today's educational landscape, marked by rapid digitalization and a redefinition of the paradigms of human interaction, the role of the university professor goes beyond the mere transmission of specialized knowledge. The quality of education in higher education is no longer determined solely by the professor's academic expertise, but increasingly depends on a complex symbiosis between “hard” skills (technical and specialized) and “soft” skills (transversal and socio-emotional). Although professional competence remains the foundation of academic authority, current labor market dynamics and the profile of new generations of students require faculty members to demonstrate greater adaptability,

empathetic communication, and advanced proficiency with digital tools. The central issue addressed in this study concerns the discrepancy between the theoretical recognition of the importance of soft skills and the extent to which they are formally integrated into continuing professional development strategies.

Recent studies suggest that, while digital and methodological competencies benefit from visible institutional support, interpersonal and self-management skills often remain the preserve of informal learning, left to the discretion of the teacher's individual experience. The main objective of this study is to investigate the level of use, perceived importance, and development needs of soft and hard skills among faculty members at the Academy of Economic Studies of Moldova (ASEM). The research aims to identify not only the core skills considered critical to success in the classroom, but also the structural barriers that limit continuous professional development. In this regard, the study seeks to answer questions such as: What is the actual role of soft skills in the success of teaching from the perspective of senior teachers? And to what extent does the current organizational climate facilitate or, conversely, inhibit the successful development of these competencies?

The methodology adopted is predominantly exploratory and inductive, using a questionnaire as the primary tool to capture both quantitative data and subjective perceptions from a representative sample of faculty members. Choosing this approach allows for a nuanced diagnosis of the phenomenon, offering an authentic perspective on the "praxiology" of competencies in the academic environment.

2. Literature Review

The paradigm shift in global higher education shifts the focus from an exclusive evaluation of technical competencies (hard skills) to an integrated recognition of transversal competencies (soft skills). In the contemporary socio-economic context, labeled as the knowledge-based economy, the academic instructor is no longer a simple transmitter of structured information, but a facilitator of learning experiences and human capital development.

According to the empirical findings formulated by Deaconu et al. (2014), the university environment must maintain a functional alignment with the volatile demands of the labor market. Higher education institutions face pressure from employers who prioritize graduates equipped with highly developed socio-emotional and communicative profiles. Consequently, to cultivate these attributes in students, the academic staff must first master and actively exhibit these transversal models. Professional skills form the baseline of scientific authority, but their operationalization is structurally conditional on the interpersonal and socio-emotional framework of the professor (Romanenko et al., 2024).

Teaching efficiency is fundamentally subordinated to the quality of human relations created inside the lecture hall. From a praxiological standpoint, Bîrsan and Cepraga (2022) state that organizational communication management inside higher education represents a crucial instrument for institutional synchronization. Effective verbal communication, active listening, and empathy are not merely natural personal traits, but professional attributes that directly dictate the absorption rate of information by students. This matches the arguments of Slama-Cazacu (2000), who notes that communicative strategies are structural components of any interaction, and in the educational framework, they prevent systemic blockages. Furthermore, Şoitu (2001) builds the concept of the "pedagogy of communication", showing

that any educational act is, at its core, a communicative process where the emotional intelligence of the instructor serves as the primary transmission channel.

At the global level, the Organization for Economic Co-operation and Development (OECD, 2018), through its *Learning Framework 2030* (also known as the *Learning Compass 2030*), underlines that the volatile socio-economic landscape demands the active cultivation of "transformative competencies". These include creating new value, reconciling tensions, and taking responsibility. For university professors, this operational framework implies a continuous transition towards a "lifelong learner" status. Continual professional development cannot remain confined to periodic updates of narrow specialized knowledge; it must encompass a structured architecture of soft skills, such as crisis management, cognitive flexibility, and stress resilience.

The acceleration of academic digitization requires a reconfiguration of pedagogical delivery. The *Technological Pedagogical Content Knowledge* (TPACK) model, synthesized by Mishra and Koehler (2006), states that efficient digital teaching is not achieved by simply adding isolated technical tools (hard skills) into the classroom. Instead, it requires a complex, hybrid convergence of three major knowledge bodies: Content, Pedagogy, and Technology.

A professor might possess excellent knowledge of the field (Content) and standard digital skills like operating basic software (Technology), but without the dynamic integration of Pedagogical methods - which relies heavily on soft skills such as adaptability and contextual flexibility - the educational outcome remains suboptimal. Therefore, technological literacy must be seen as a hybrid competency, whose success depends entirely on the teacher's cognitive flexibility and relational capacities.

Despite the widespread literature regarding the importance of soft skills in western corporate and academic environments (Miller, 2024), there is a visible research gap regarding the practical and empirical diagnosis (praxiology) of these competencies within the specific post-Soviet transitional higher education landscape of the Republic of Moldova. Most institutional strategies for professional training remain technically oriented, focusing on rigid methodologies and administrative metrics, while ignoring the institutionalized, formal training of emotional and relational intelligence.

This study addresses this specific gap. The scientific contribution consists of a multidimensional diagnosis of the relationship between the teacher's profile (seniority, rank) and their professional reality within a major economic university (ASEM), offering an empirical framework designed to transform spontaneous, self-taught soft skills acquisition into targeted, systematic institutional policy.

3. Methodology

To ensure scholarly rigor and allow replication by other researchers, the methodological apparatus is structured as follows:

- The study uses a mixed-methods design (quantitative and qualitative), descriptive, and exploratory, operating through a praxiological approach to evaluate the operational reality of academic skills.
- The empirical data collection was conducted over a four-week period, between April 15, 2025, and May 15, 2025.

- The target population consists of the entire academic staff of the Academy of Economic Studies of Moldova (ASEM). A non-probability, purposive sampling method combined with convenience sampling was applied. The final validated sample included $N = 52$ active faculty members. The sample exhibits high internal qualitative representation relative to the institution's senior management and teaching core, as it includes a heavy concentration of Associate Professors (66%) and faculty members with over 20 years of higher education experience (60%), who directly shape the pedagogical culture of the university.
- The primary instrument was an original structured questionnaire, distributed digitally. The questionnaire consists of 19 items: 15 closed-ended questions structured on a 5-point Likert scale (ranging from 1 = Not at all/Very low to 5 = Extremely/Very high) used to measure the frequency of tool usage and perceived relevance, and 4 open-ended questions designed to collect qualitative feedback and define the ideal profile of the modern instructor.
- Quantitative data was processed using descriptive statistics, frequency analysis, and cross-tabulation to correlate variables (e.g., teaching experience vs. training participation). Qualitative data from open-ended responses underwent structural thematic content analysis, using open coding to extract recurring thematic categories.
- The primary limits of the study include the sample size ($N=52$), which restricts generalized statistical extrapolations to the entire national higher education system of Moldova, and the potential for social desirability bias inherent to self-reporting surveys on professional competency levels.

4. Results and Discussion

In the sample surveyed ($N=52$ valid respondents), the vast majority of respondents are faculty members with extensive professional experience and advanced academic ranks. The distribution by academic rank indicates that 66% of respondents are associate professors, followed by lecturers (14%) and teaching assistants (12%). Only one respondent (2%) holds the title of full professor, and two other respondents hold specific roles as methodologists (support staff involved in methodological activities).

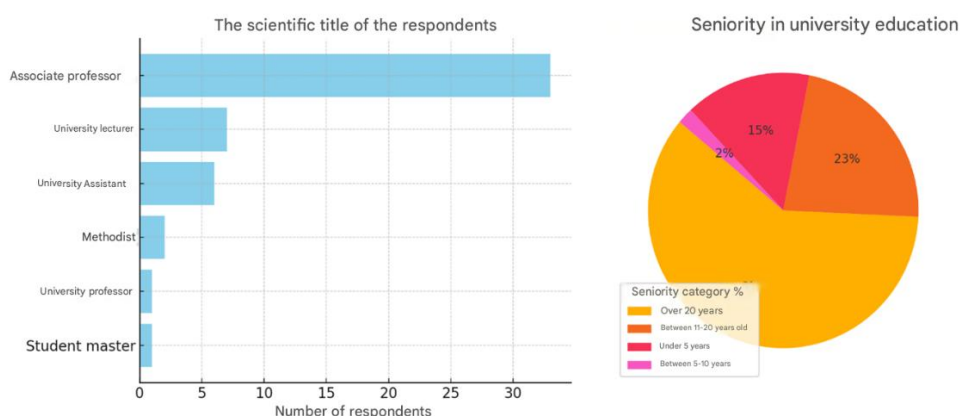


Figure 1. Distribution of respondents by academic title and years of experience in higher education

Source: prepared by the authors based on data collected during the research

From the perspective of seniority in higher education, the distribution is also uneven: approximately 60% of respondents have over 20 years of teaching experience, 23% have between 11-20 years, 15% have less than 5 years, and only ~2% fall within the 5-10-year range (Figure 1). A profile of the sample thus emerges that is dominated by senior faculty members (mostly associate professors with over two decades of experience), a fact that may influence perceptions of professional competencies and training needs.

The teachers surveyed indicated which types of skills they use most frequently in their current professional work (with the option to select up to 3 options). The results reveal a clear predominance of communication and digital skills: nearly all respondents frequently use communication and interpersonal skills (94% of respondents) and digital skills (88%) in their academic work. Next in terms of frequency are scientific research skills (indicated by ~70% of respondents), reflecting the important role of research activity at the university. In contrast, administrative skills (managing organizational activities) and leadership skills (management, institutional coordination) were mentioned by less than half of the sample (approximately 38% and 34%, respectively).

At the bottom of the list, adaptability and conflict resolution skills were selected by about 34% of respondents. These results suggest that, in daily practice, teachers rely primarily on soft communication skills (teaching, interacting with students and colleagues) and hard digital skills (using educational technologies), which reflects both the current demands of the modern educational process and the multiple roles that a teacher fulfills (for example, effective communication of information and the use of digital e-learning platforms).



Figure 2. The types of skills that teachers report using most frequently

Source: prepared by the authors based on data collected during the research

Regarding the predominant form of interaction with students, the majority of faculty members (approx. 74%) indicated that teaching takes place in person (in a traditional classroom setting). A smaller percentage (17%) uses a hybrid teaching format (alternating between online and in-person), while the rest mentioned either individual tutoring/practical activities (~8%) or other specific forms. It is worth noting that no respondent indicated exclusively online teaching as the primary method, which reflects the institution's specific nature (economic profile) and, possibly, a return to direct interaction post-pandemic. This context also explains why digital skills are so widespread: even in face-to-face teaching,

teachers use digital tools (presentations, course management platforms, online resources). The few who did not mention digital skills among their current uses are predominantly senior teachers who teach face-to-face (without advanced technologies) or are involved in individual tutoring - situations where technology plays a lesser role.

Another aspect of assessing the current situation focused on participation in continuing professional development. The question “How often do you participate in continuing professional development activities (courses, conferences, workshops)?” reveals a moderate commitment to professional development: more than half of the respondents (52%) indicated that they participate annually, and nearly a third (29%) even more frequently, on a quarterly basis. Only ~13% attend courses or conferences monthly, while a small group (approx. 4% + 4%) rarely or never participates in such activities. These figures show that, although there is interest in training (about 81% participate in training at least annually), very few do so frequently (monthly), and a small number do not participate at all. When correlated with years of service, it is observed that teaching staff with extensive experience (over 20 years of service) participate in training at a high rate (90% of them have taken courses in the last 2 years), a sign that adapting to new requirements motivates them to learn continuously. Those at the beginning of their careers have slightly lower participation rates (approximately 75% of those with less than five years of experience have recently attended training sessions), possibly due to a lack of time or opportunities. A positive aspect highlighted by the study is the perception of organizational culture: 85% of respondents believe that the institution’s organizational environment encourages continuous learning and collaboration among faculty members, while 13% believe that this is only partially encouraged. Only one person (2%) responded negatively, perceiving a lack of institutional support in this regard. This broad consensus (98% in total or partial agreement) suggests the existence of an organizational climate conducive to professional development - a favorable premise for the implementation of training strategies.

Thus, an assessment of the current situation shows that ASEM’s academic staff make extensive use of both soft skills (particularly communication and interpersonal skills) and hard skills (digital and subject-specific skills) in their teaching activities. Faculty members have a positive attitude toward continuous learning, with most participating regularly in professional development and perceiving the institution as supportive of this effort. However, there are also limitations: a small segment of faculty members is hardly involved in training at all, and the general pace of training is predominantly annual, which may indicate time or resource constraints (aspects explored in the following sections). Overall, we can state that there is an awareness of the importance of professional competencies (both soft and hard) and a favorable foundation for initiatives to develop these competencies within the analyzed university environment.

Qualitative and quantitative analysis of experimental data. This section provides a detailed analysis of teachers’ responses regarding the importance of soft and hard skills, their level of mastery and development, as well as perceptions of their impact on teaching practice. The analysis combines a quantitative approach (descriptive statistics, frequency distributions illustrated graphically) with a qualitative approach (examination of open-ended responses and comments provided by respondents) to offer the most comprehensive picture of the phenomenon.

Hard skills-essential for teaching. Teachers were asked to select the technical (hard) skills they consider essential for their work. Options included specific digital skills (using

Microsoft Office, e-learning platforms, specialized software), foreign language skills, research methodologies, financial analysis, etc. The results reveal a common core of technical skills perceived as critical: at the top is the use of Office-type applications (word processing, spreadsheets, presentations) - mentioned by ~77% of respondents, followed by e-learning skills (online teaching platforms, e.g., Moodle) - 66%, and knowledge of a foreign language (of international use) - 64%. Approximately 58% of respondents emphasize the importance of scientific research methodology (planning and conducting studies, data analysis), which reflects the integration of research and teaching activities. In second place is the use of specialized software (SPSS, EViews, etc.) for analysis and projects, mentioned by ~28% of faculty members, closely followed by financial analysis skills (26%). A small number of respondents (1-2 people each) also indicated other hard skills of interest, such as AI (artificial intelligence), project management, or “skills related to the courses taught, including social media,” signaling specific individual needs. The overall distribution is illustrated in Figure 3.

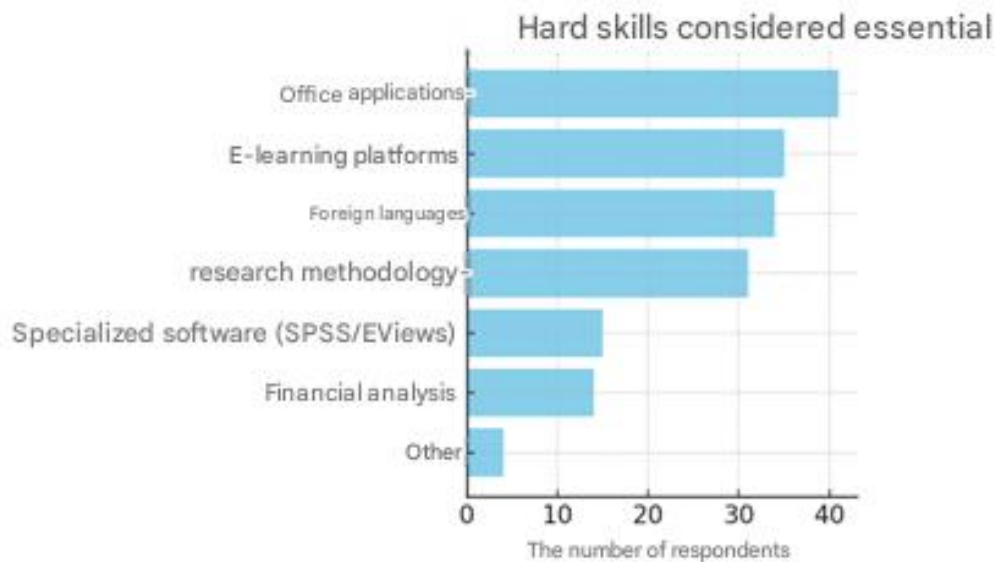


Figure 3. Hard skills considered essential by teachers

Source: prepared by the authors based on data collected during the research

These findings confirm that, in addition to specialized knowledge, faculty members at a business school require a set of cross-cutting hard skills: the effective use of common digital tools, teaching in virtual environments, communication in a foreign language (to access international literature and engage in external collaborations), and research methodology. The high level of importance attributed to these skills correlates with the degree to which they are institutionally encouraged: in response to the question “To what extent do you consider that the institution encourages the development of these hard skills?”, respondents provided ratings on a scale of 1–5, with an average response of 3.94. More than two-thirds (~74%) rated the level of encouragement as high (a score of 4 or 5 out of 5), 21% rated it as moderate (a score of 3), and only 6% perceived it as low (a score of 2); notably, no faculty member considered that the institution does not encourage the development of technical skills at all (score of 1). These data suggest that there are visible institutional initiatives (IT training, research facilities, etc.), but there is also room for improvement to achieve a perception of “very high” encouragement among all employees.

As expected, the majority of teachers (85%) reported that they had participated in courses or training programs to develop technical skills (IT, software tools, foreign languages, etc.) over the past two years. The 15% who did not do so are split relatively evenly between younger staff (with less than 5 years of experience) and senior staff, a sign that barriers to participation (discussed later) can affect various categories of staff. Importantly, there is a critical mass of staff already engaged in developing hard skills, whom the institution can leverage as promoters of digital and methodological innovation.

Soft skills perceived as important. A central objective of the study was to identify the soft skills (transversal, socio-emotional, and intrapersonal) considered most essential in teaching. Teachers were able to choose up to 3 from a predefined list of soft skills. Effective communication clearly emerged as a priority: 90% of respondents selected “effective verbal communication” as a very important soft skill in their work. Additionally, approximately 60% cited empathy and active listening, highlighting the need to understand and connect with students, and another 60% mentioned adaptability to change, an essential quality in a dynamic educational environment. Critical thinking was chosen by 55% of respondents, suggesting that teachers value fostering a critical mindset, not just imparting factual knowledge. Next are emotional intelligence (45%) - the ability to manage one’s emotions and relate empathetically - and teamwork (42%) as important skills, reflecting both the teacher-student relationship and collaboration among colleagues within departments or on projects. Skills such as time management were mentioned by 32% of respondents, and resilience and stress management by about 26%, a sign that a considerable portion of faculty members feel the pressure of academic stress and find the ability to manage it useful. Leadership (12 mentions, 23%) appears to be a lower priority among individual soft skills - an understandable finding, since not all faculty members hold leadership roles, and those who do not coordinate teams may not perceive leadership as an immediate necessity. The vast majority of teachers recognize the importance of communication and interpersonal skills, along with empathy and adaptability, as the foundation of effectiveness in education. Figure 4 summarizes these results.

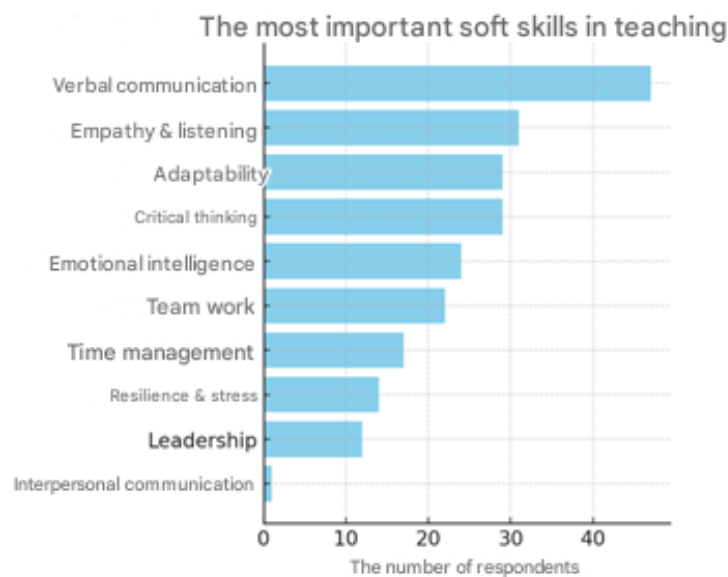


Figure 4. The top soft skills considered necessary for teaching (ranked by frequency of mention)

Source: prepared by the authors based on data collected during the research

Ways of Acquiring Soft Skills. An interesting insight gained from the survey is how teachers acquired most of the soft skills they possess. The responses highlight the predominance of informal and experiential learning: 94% of respondents indicated that they developed their soft skills through professional and personal experience, learning from classroom practice and real-life interactions with students and colleagues. Furthermore, more than half ($\approx 51\%$) mentioned that they were self-taught in this process - they cultivated their communication, time management, and empathy skills on their own, likely through personal reflection, reading, observation, and self-improvement efforts. In contrast, only 40% participated in dedicated training for soft skills (communication workshops, pedagogy courses, personal development, etc.).

The Importance of Soft Skills in Teaching Success. A key question explored teachers' perceptions of the role that soft skills play in their teaching success, compared to hard skills. The responses, expressed as percentages (value ranges), unanimously point toward recognition of the importance of soft skills: no respondent considered that soft skills contribute less than 25% to success, a sign that all view these skills as at least as important as subject-matter expertise. Most respondents - 55% - believe that 50-75% of success in the classroom is due to soft skills, while another 26% go even further, estimating that soft skills account for more than 75% of success compared to hard skills. The remaining 19% consider the contribution of soft skills to success to be in the range of 25-50%; no faculty member cited a lower percentage. In practice, the overwhelming majority of faculty members confirm the paradigm that "a good teacher is defined not only by their expertise in the field, but also by their ability to communicate, motivate, understand, and connect with students."

The impact of soft skills on various aspects of professional practice. To elaborate on how soft skills specifically influence teachers' performance, respondents were asked what exactly "directly influences soft skills," with the option to select up to three aspects. The results highlight the multiple and interconnected effects of these skills. The most frequently mentioned positive consequence of a high level of soft skills is the quality of communication with students and colleagues - 46 respondents (87%) indicated that soft skills (e.g., empathy, presentation skills, active listening) lead to better, clearer, and more effective communication with students and the academic community.

The second effect, closely linked to the first, is overall professional performance: $\sim 66\%$ believe that mastering soft skills enhances teaching and academic performance (for example, an empathetic and communicative teacher achieves better results in the teaching-learning process). In third place (60%) is the ability to analyze information and form well-reasoned opinions, suggesting that teachers view soft skills as higher-order cognitive abilities (critical thinking, reflection) that help them process information and make well-informed decisions. This is closely followed by effective teamwork (57%): soft skills (such as cooperation, open communication, and emotional intelligence) facilitate collaboration with colleagues within departments, research projects, or other institutional stakeholders, thereby increasing team efficiency. A smaller but still significant number of respondents believe that soft skills directly influence problem-solving ability (34%) - for example, creative thinking, stress management, and flexibility help in finding solutions to challenges that arise in the educational process.

Managing emotions (both one's own and students') was cited by 19% of respondents as being influenced by soft skills, and conflict management by 15%; these lower percentages indicate either that not all teachers frequently encounter conflict situations, or that some

consider conflict management a separate, more specialized component of competencies. Figure 5 provides an overview of these influences.

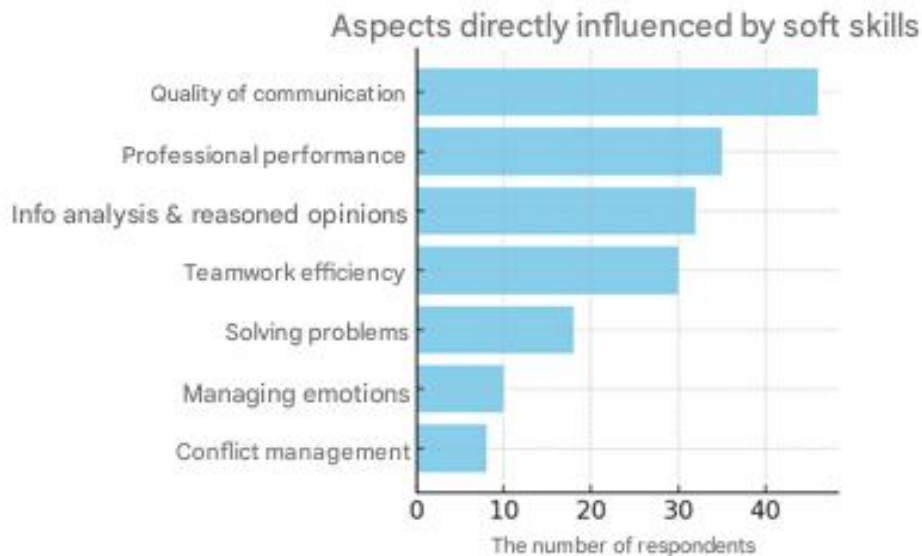


Figure 5. Aspects of teaching practice directly influenced by the level of soft skills (teachers' opinions, frequency of mention)

Source: prepared by the authors based on data collected during the research

Overall, these findings confirm the existing literature, which emphasizes the critical role of soft skills in the educational environment. A teacher with well-developed interpersonal skills can communicate the subject matter more effectively, motivate and inspire students, collaborate more efficiently with colleagues, and handle challenges (discipline issues, conflicts, adapting content to the class profile, etc.) with calm and creativity. Therefore, investing in the development of these skills has a multiplier effect: not only does it improve the individual performance of the teacher, but it can also raise the quality of interactions across the entire organization.

Future development needs – skills that need to be emphasized. An analysis of future development needs reveals a convergence of responses toward three priority areas of nearly equal importance: digital skills (60%), interpersonal skills (58%), and research and innovation skills (58%). Secondly, leadership and management skills are mentioned by 28% of respondents, reflecting aspirations toward administrative roles. To a lesser extent, specific needs such as conflict management, optimizing official correspondence, and tailoring training to specific disciplines were highlighted. Figure 6 illustrates the distribution of the main responses.

This feedback underscores the imperative of continuously adapting to the challenges of digitalization and e-learning by improving IT skills. At the same time, it confirms the growing awareness of the need to strengthen interpersonal skills (empathy, adaptability), which are vital in student-centered educational paradigms. The prioritization of research and innovation skills reflects the aspiration toward scientific excellence and curriculum modernization, while the interest in leadership indicates the need for specific training in educational management for potential coordination roles. Specific suggestions regarding conflict management or administrative communication point to specific areas that can be addressed through customized training modules.

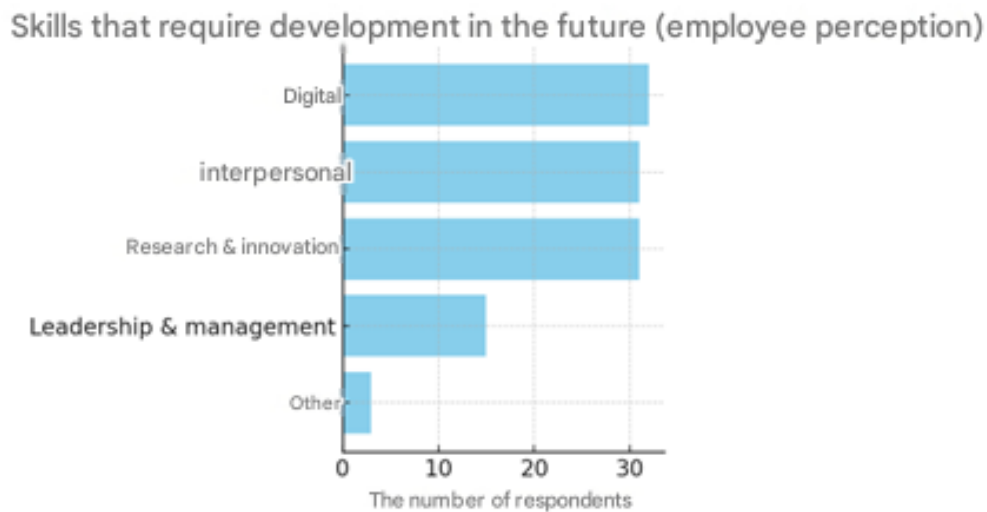


Figure 6. Types of skills perceived as requiring further development within the institution

Source: prepared by the authors based on data collected during the research

This feedback underscores the imperative of continuously adapting to the challenges of digitalization and e-learning by improving IT skills. At the same time, it confirms the growing awareness of the need to strengthen interpersonal skills (empathy, adaptability), which are vital in student-centered educational paradigms. The prioritization of research and innovation skills reflects the aspiration toward scientific excellence and curriculum modernization, while the interest in leadership indicates the need for specific training in educational management for potential coordination roles. Specific suggestions regarding conflict management or administrative communication point to specific areas that can be addressed through customized training modules. *The main obstacles to professional development.* One key question focused on identifying the factors that limit the development of teachers' professional competencies. Respondents could select up to two obstacles from a list (including the option to add others).

Approximately 77% of respondents (41 faculty members) cited "lack of time" as a major factor hindering their professional development. This reflects the heavy workload of university faculty (lectures/seminars, preparing materials, administrative tasks, research, student advising, etc.), leaving little time available for training or additional self-study. The second obstacle, mentioned by 43% of respondents, is the lack of institutional resources necessary for professional development.

This issue may include a lack of funding for attending conferences or courses, limited access to high-quality training programs, insufficient resources for developing practical skills, or even inadequate managerial support. At the same level (43%) is the lack of individual motivation among teachers. Such a percentage indicates that nearly half of teachers acknowledge that, beyond external factors, low motivation constitutes an impediment to continuous professional development. The next most common obstacle (12%) is the mismatch between training offerings and teachers' needs. In other words, a certain number of teachers believe that the available training programs are not relevant, up-to-date, or tailored to the specifics of their subject and their interests, which discourages them from participating. Figure 7 summarizes these results.



Figure 7. Types of skills perceived as requiring further development within the institution

Source: prepared by the authors based on data collected during the research

The Ideal Profile of the Modern University Faculty Member - Qualitative Perspectives. The final part of the qualitative analysis focuses on the professors' open-ended responses to the question: "How would you describe, in a few words, the ideal profile of a modern university faculty member?" This question generated a series of descriptions and adjectives that allow us to understand the collective vision of the model of excellence in the teaching profession.

Analysis of these responses reveals certain recurring key traits:

- *High professional and teaching competence.* Many respondents emphasized that an ideal teacher must be "professional" and "competent," with a solid background in both their field of study and teaching. Descriptions such as "intelligent, well-prepared, and using modern methods" or "excellent teaching skills" were frequently cited. The emphasis, therefore, is on mastery of the scientific content and the ability to convey it effectively (pedagogical skills).
- *Empathy and openness toward students.* The most frequently mentioned quality was empathy. The term "empathetic" appears explicitly nine times in the responses, often accompanied by "and a good listener." The ideal professor is perceived as being close to students, capable of understanding their needs and difficulties. Likewise, being "close to students," "friendly," and "communicative" are ideas that emerge from multiple descriptions.
- *Openness to new ideas and adaptability.* About 10 respondents used the word "open" in phrases such as "open to knowledge/innovation" and "open to new ideas." This implies both a desire for continuous professional development (lifelong learning) and receptiveness to new teaching methods or technologies. Adaptability is also confirmed by terms such as "flexible" or "adaptable" (mentioned at least 4 times). The ideal teacher can adapt to changes in the curriculum, new generations of students, and various unforeseen situations.
- *Motivation and passion.* Several terms highlight the importance of passion for the profession - "passionate," "dedicated," and "committed" were mentioned repeatedly.

Likewise, “motivated” appears several times, indicating that an ideal teacher is motivated, enthusiastic, and puts their heart into what they do, which in turn motivates and inspires students.

- *Communication and collaboration skills.* The ideal candidate is a “good communicator” and “public speaker” who is effective at conveying messages, but also “collaborative” (a term mentioned in several responses).
- *Integrity and humanism.* Character traits such as “fairness,” “integrity,” “patience,” and “calmness” were also mentioned. Some emphasized that the ideal teacher should be “respectful,” “understanding,” and “kind,” suggesting an ethical and empathetic profile rather than an authoritarian one.
- *A focus on continuous development.* Many descriptions suggest the idea of “continuous learning” - an ideal teacher is “always improving,” “up to date with the latest research,” and “keeping pace with technology.” Thus, intellectual flexibility and curiosity are integral parts of this profile.

One respondent’s concise description of the ideal profile goes as follows: “Intelligent, professional, flexible, approachable to students, passionate about their work, open to innovation, and empathetic.” This statement encapsulates most of the qualities mentioned by others and can serve as a composite sketch of the educator the academic community desires. It is worth noting that the emphasis is placed on both professional competencies (intelligence, professionalism) and soft skills (empathy, communication, adaptability, passion). This reinforces the message of the entire study: the ideal balance between hard and soft skills is essential for teaching excellence. Without solid knowledge and technical skills, a teacher cannot deliver quality content; however, without soft skills (communication, empathy, openness), they cannot effectively convey that content and cannot truly educate students.

5. Conclusions

This study has highlighted the indispensable nature of a holistic approach to the professional training of university faculty, demonstrating that effectiveness in contemporary higher education depends on a functional balance between hard skills (subject-matter expertise) and soft skills (transversal skills). The praxiological analysis conducted within ASEM confirms that, although academic expertise remains the pillar of scientific authority, pedagogical success is mediated by the ability to communicate, empathize, and adapt to a digitalized environment.

A key finding of the study is the existence of a discrepancy between the recognition of the value of transferable skills and the institutional mechanisms for developing them. The data indicate that the development of interpersonal and research skills is often left to individual effort and informal learning, a process hindered by major structural obstacles, particularly a chronic lack of time (77%) and limited financial resources. This time pressure, generated by administrative and teaching tasks, constitutes the main barrier to innovation and scientific performance.

In conclusion, the transition to a student-centered education aligned with the demands of the knowledge-based economy requires a paradigm shift at the organizational level. It is imperative that the institution become a catalyst for skills development by:

- Institutionalizing cross-disciplinary training by creating programs focused on soft skills and research, moving beyond the traditional model of self-directed learning.
- Digitally optimizing processes and reducing administrative burdens through automation, to free up time for professional development.
- Providing managerial and motivational support through the implementation of incentive mechanisms that recognize and reward excellence in both dimensions of the teaching profile.

Only by strategically integrating these areas can the university ensure a resilient faculty capable of delivering a superior learning experience and strengthening its academic prestige within the European context.

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HUMAN DIGNITY AS THE ETHICAL FOUNDATION OF SUSTAINABLE ECONOMIC DEVELOPMENT

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Abstract: *This paper examines the role of human dignity as a fundamental ethical foundation of sustainable economic development. Although human dignity is widely recognized in philosophical and legal frameworks, its implications for economic systems remain insufficiently explored. In this context, the study proposes a normative three-dimensional model for evaluating economic activities in relation to human dignity, based on real autonomy, non-instrumentalization, and minimum well-being. The model builds on Kantian ethics and the capability approach developed by Amartya Sen, while also being consistent with the normative framework of the Sustainable Development Goals. To illustrate its applicability, the model is applied to the fast fashion industry. The analysis indicates a low level of compatibility with human dignity, particularly in terms of limited autonomy, the treatment of workers as means rather than ends, and insufficient working conditions. These findings reflect broader structural tensions between profit-oriented economic systems and the ethical requirements of respecting human dignity. The paper concludes that sustainable economic development cannot be achieved without integrating human dignity as a guiding normative principle. It also suggests several directions for reducing the gap between economic practices and dignity-based standards, including stronger labor regulations, greater transparency in supply chains, and improved access to opportunities that enhance individuals' real freedoms.*

Keywords: human dignity; sustainable development; capability approach; autonomy; ethical evaluation.

JEL Classification: A13; D63; O10; Q01.

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1. Introduction

Human dignity is usually interpreted as the normative foundation of fundamental human rights and freedoms. The role of dignity is rigorously studied and theorized from a philosophical and legal perspective, but its valences are not sufficiently explored through the prism of economic systems and sustainable development.

In the contemporary context, marked by globalization, the persistence of social inequalities and structural economic transformations, a reassessment of human dignity is required as one of the ethical pillars of sustainable economic development.

Within the framework of most contemporary economic systems, objectives such as efficiency, economic growth and profit maximization prevail. However, these objectives often contradict the ethical demands of human dignity. In this context, the Kantian idea, according to which the individual must always be treated as an end in himself and never only as a means, provides a normative ethical framework for sustainable economic development and for the protection of human dignity.

The paper argues that economic development cannot be considered sustainable in the absence of the effective integration of human dignity as a normative principle. Without it, economic development risks becoming not only inequitable but also unsustainable in the long term. An economy that ignores the intrinsic value of the person undermines its own conditions of legitimacy and stability. However, the full integration of human dignity into

the economy is limited by the structural constraints of the market economy, which makes certain compromises inevitable.

2. Literature Review

The concept of human dignity has been extensively addressed in philosophical and legal scholarship, where it is commonly understood as the intrinsic and inalienable worth of every human being. The literature on human dignity as an ethical basis for sustainable economic development starts from moral philosophy and gradually reaches development economics and current sustainability models. In this process, an interdisciplinary approach is emerging in which ethics and economics are closely linked. An important starting point is Immanuel Kant, who in *Groundwork of the Metaphysics of Morals* (1785) argues that dignity is an intrinsic value of each person. Human being must be treated as an end in himself, not as a means, which becomes a moral basis for the idea of respect and for limiting exploitation.

An important change occurs in development economics through Amartya Sen in *Development as Freedom* (1999), where development is understood as the expansion of people's real freedoms. Poverty is not just a lack of income, but a lack of real possibilities for action and choice. This approach is continued by Martha Nussbaum in *Women and Human Development* (2000), who proposes a list of essential capabilities for a dignified life and transforms dignity into a clear criterion for public policies. Jeffrey Sachs in *The Age of Sustainable Development* (2015) argues that poverty reduction, environmental protection and international cooperation are essential for sustainable development based on dignity.

The literature shows an evolution from the philosophical idea of dignity, to the critique of the market economy, then to the development economy centered on freedom and capabilities, and finally to current models of sustainability.

Against this background, the present study contributes by proposing a structured three-dimensional model that operationalizes human dignity through autonomy, non-instrumentalization, and minimum well-being, bridging normative theory and practical evaluation.

3. Methodology

This study adopts a qualitative and normative research design based on a review of the relevant academic literature and conceptual analysis. The methodological approach includes analysis, synthesis, comparison, and deduction, used to integrate insights from Kantian ethics, Amartya Sen's capability approach, and the Sustainable Development Goals.

The research develops a three-dimensional evaluative model grounded in real autonomy, non-instrumentalization, and minimum well-being. This model serves as an analytical framework for assessing the compatibility of economic activities with human dignity.

Its applicability is illustrated through a case study of the fast fashion industry. The analysis relies on secondary data from existing academic sources and does not involve primary data collection. The evaluation is interpretive and focuses on identifying structural patterns rather than statistical measurement.

4. Results and Discussion

As stated in the preamble to the Universal Declaration of Human Rights, “recognition of the inherent dignity and of the equal and inalienable rights of all members of the human family is the foundation of freedom, justice and peace in the world” [Declaration]. And so, within contemporary society, human dignity transcends the realm of abstract concepts, being an inalienable right.

In the Republic of Moldova, dignity is not only an ethical aspiration, but also a supreme value, constitutionally guaranteed. Thus, in the Constitution of the Republic of Moldova, human dignity is declared a supreme value, along with the rule of law, civic peace, democracy, fundamental human rights and freedoms, the free development of human personality, justice and political pluralism (Constitution of the Republic of Moldova, 2022).

From an ethical perspective, human dignity implies the recognition of the intrinsic value of each individual, a value that cannot be conditioned by external factors, economic or social performance. This implies the obligation not to reduce the person to a simple instrument in the mechanisms of production or consumption. Dignity is manifested through the freedom of individuals to exercise their capabilities and to live a life based on self-respect and social recognition. Dignity is also the essential value of contemporary international society, it is the origin of all fundamental human rights and freedoms... conceived as the cornerstone of the international, regional and national normative framework for the protection of human rights (Dorul & Cazacu, 2021).

The subject of human dignity has been one of the central themes of reflection for many thinkers. The term “dignity” itself comes from the Latin *dignitas*, which originally referred to worthiness, personal merit, social status or prestige.

For the illustrious German philosopher Immanuel Kant, man has dignity because he is autonomous and capable of following the moral law (an end in itself). The foundation of Kantian morality is the obligation to treat humanity as an end in itself and never as a mere means. “So act that you use humanity, whether in your own person or in the person of any other, always at the same time as an end, never merely as a means”, wrote Kant in his fundamental work on ethics, *The Groundwork of the Metaphysics of Morals*, originally published in 1785 (Kant, 1997, p. 38).

This imperative can be applied in all spheres of human life, including the economic sphere, where the individual should not be reduced to the status of a “resource” or a simple instrument of production in the service of capital growth. If the economy itself is not an instrument at the service of man, but only an end in itself, man, his needs, his freedoms can easily be neglected. Applying the Kantian perspective allows for a critical analysis of economic relations, in which efficiency and profit are often prioritized to the detriment of human dignity.

For example, during the Industrial Revolution in Great Britain, rapid economic development and the maximization of production were treated as priority objectives, often to the detriment of human well-being. Working conditions were often precarious, health risks were high, and wages were very low. Workers, including children, were subjected to extreme working conditions, with long hours. Friedrich Engels argued that: the worker is treated as a commodity, like any other article of trade. (Engels, 1887). Even though much time has passed since then, eloquent examples in this regard can still be found in the contemporary period. In the fast fashion industry, the pressure for rapid production and low costs often

leads to work in precarious conditions, which reflects the tendency to subordinate the dignity of workers to the imperative of maximizing profit.

The elevated status of the idea of human dignity is also reflected in Immanuel Kant's famous dictum: "In the kingdom of ends everything has either a price or a dignity. What has a price can be replaced by something else as its equivalent, what on the other hand is raised above all price and therefore admits of no equivalent has a dignity" (Kant, 1997, p. 42). Thus, a radical distinction is established between two ways of attributing value in the moral universe. If an individual or a human activity is treated through the prism of the "equivalent", it is automatically relegated to the category of a commodity. By specifying that what has dignity "has no equivalent", Kant transforms human dignity into an argument against instrumentalization. If price allows for replacement (substitution), dignity imposes respect (recognition of intrinsic value).

In the 20th century, philosopher and economist Amartya Sen advanced the idea that human freedom can be defined, in part, as the capacity to shape one's own life. He proposed a systemic view of development, in which freedom is not just an objective but an engine composed of five interconnected pillars. "Five distinct types of freedom, seen in an "instrumental" perspective, are particularly investigated in the empirical studies that follow. These include (1) political freedoms, (2) economic facilities, (3) social opportunities, (4) transparency guarantees and (5) protective security" (Sen, 1999, p. 10). Each of these types of rights and opportunities helps to advance the general capability of a person. They may serve to complement each other. Public policy to foster human capabilities and substantive freedoms can work through the promotion of these distinct but interrelated instrumental freedoms.

Amartya Sen develops the theory of capabilities, emphasizing what a person can actually do or be. In this view, the possession of a resource is irrelevant if the individual does not possess the substantial freedom to convert it into real results. Thus, development is no longer seen as a simple expansion of material goods, but as a process of eliminating the "unfreedoms" that prevent people from achieving their human potential, transforming the individual from a passive recipient of assistance into an active agent of his own life (Sen, 1999). At the heart of Sen's theory is the distinction between means and ends: income is only an instrument, while capability represents the freedom of man to choose the life he likes. The intersection of the theory of capabilities and human dignity redefines the purpose of modern economics. A human-centered economy ceases to pursue only the expansion of material goods.

If within the economic system the individual is reduced to a resource that is evaluated only in terms of his productivity and does not have the freedom to choose, then the value of the person is implicitly correlated with his economic performance. In this sense, human dignity, currently understood as an intrinsic value, independent of external criteria, comes into tension with the imperatives of the market, which presuppose comparative evaluation. We can observe this problem on the labor market. Most of the time, the employee is viewed only as a replaceable resource, and the employment relationship is reduced to a simple contract, without any emphasis on respecting the dignity of the person. The concept of decent work assumes that economic activity must be carried out in conditions that respect the physical and mental integrity of the individual, provide security and allow a dignified existence. Having a job does not always protect people from the risk of poverty. Poverty of the employed population is associated with low wages, poor skills, insecure employment and often involves involuntary part-time employment. At the same time, it is related to the type

of household in which the employed persons live and to the economic status of the other members of the household (Burghelea, 2012).

Currently, dominant economic systems are built more around efficiency, productivity and profit maximization. But these objectives often conflict with the ethical demands of respect for the individual as an end in itself. In this sense, Kant's perspective on human dignity provides a reliable normative foundation for reassessing the objectives of the economy. Viewing the individual exclusively as a means of production or as a simple economic factor contradicts the idea of the intrinsic value of dignity and undermines the premises of sustainable development.

The tension between the economic logic oriented towards profit and the ethical demands of human dignity imposes the need to identify a development model that can reconcile them. The concept of sustainable development provides this theoretical and practical framework capable of integrating the economic, social and human dimensions of progress. The recognition of human dignity as an intrinsic value, and not as a market price, imposes on economic systems, which are intended to be sustainable, the priority of the well-being and autonomy of the person. Thus, profit ceases to be an end in itself, becoming a subordinate mechanism to human development.

The terminological consecration of sustainable development took place in 1987, with the launch of the document "Our Common Future", prepared by the World Commission on Environment and Development (also known as the Brundtland Report). This report proposed an innovative vision, focused on harmonizing economic activity with the protection of natural ecosystems, the objective being to identify a global path that would guarantee the evolution of humanity in the long term, not just isolated or temporary advantages. The fundamental definition established in this context describes sustainability as a process capable of ensuring the well-being requirements of the current population, without endangering the resources and opportunities that tomorrow's generations will need for their own development. The Brundtland Report substantiated the need for a balance between the aspirations of current generations and the ability of future generations to meet their own needs (United Nations, 1987).

Sustainable development is based, among other things, on the idea that current generations have a responsibility to leave to future generations an environment that is at least as habitable as the present one. The sustainable development paradigm culminated in the establishment by the United Nations of 17 Sustainable Development Goals (SDGs) to be achieved by 2030 (United Nations, 2015).

The Sustainable Development Goals (SDGs), adopted under the auspices of the United Nations, explicitly include dimensions such as decent work, reducing inequalities, quality education and well-being. These goals indicate an implicit recognition that economic development cannot be separated from respect for human dignity. The global framework of the 2030 Agenda for Sustainable Development, adopted by the United Nations, places human dignity at the heart of the 17 Sustainable Development Goals. The document stipulates that the main goal is "to eradicate poverty in all its forms and dimensions", which is very important for the realization of human dignity (United Nations, 2015).

From the perspective of this paper, the SDGs can be interpreted as a concrete expression of the integration of human dignity into development policies. They are pillars for the implementation and protection of human dignity.

Thus, SDG 1 (End poverty in all its forms everywhere) and SDG 10 (Reduced inequalities within and among countries) reflect the need to ensure a minimum level of material well-being, without which human dignity is compromised. SDG 3 (Ensure healthy lives and promote well-being for all at all ages) and SDG 4 (Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all) contribute to the development of human capacities, essential for the exercise of autonomy and social participation.

At the same time, SDG 8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all) introduces the concept of "decent work", which derives directly from the idea of respect for the dignity of the person in the economic sphere. SDG 16 (Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels) guarantees the institutional framework necessary to protect fundamental rights and freedoms.

Respecting dignity involves not only ensuring present well-being, but also protecting resources and opportunities for future generations. Thus, the ecological dimension of the SDGs (such as SDG 13 – Take urgent action to combat climate change and its impacts or SDG 15 – Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss) becomes an integral part of a broader vision of dignity (United Nations, 2015).

Therefore, the Sustainable Development Goals are not just a set of public policy directions, but can be understood as a normative mechanism through which human dignity is translated into concrete economic and social practices. They reflect a paradigm shift, in which development is conceived not only as the accumulation of resources, but as a process oriented towards the expansion of real freedoms and opportunities of individuals.

Sustainable economic development involves not only economic growth, but also ensuring social equity, environmental protection and respect for fundamental human rights, including human dignity. The need to achieve a balance between three basic dimensions is emphasized: economic prosperity, social inclusion and environmental protection. But the social component is frequently minimized, being limited to a simple monitoring of quantitative indicators, such as the volume of income or the employment rate. This approach neglects respect for human dignity, as an intrinsic value and normative criterion of development.

Integrating human dignity into the paradigm of sustainable economic development is not just about ensuring a material minimum. It involves guaranteeing decent working conditions, equitable access to resources and the real possibility for individuals to actively engage in socio-economic life. From this perspective, the success of development cannot be measured exclusively in terms of gross domestic product, but also by the impact on the quality of life and on the real freedoms of individuals. Therefore, sustainable economic development cannot be conceived without a strong ethical foundation. Human dignity must function as a criterion for evaluating and guiding economic policies.

But the full integration of human dignity into the market economy is limited by such structural constraints as global competition, cost pressures, and capital dynamics. These conditions generate situations in which economic actors are forced to prioritize efficiency over ethical standards. A structural tension arises between the normative ideal of dignity and the realities of the global economy. However, achieving economic development fully

compatible with ethical demands involves regulating and guiding the market economy through public policies and international standards.

Sustainable economic development is not only an economic objective, but also an ethical one. Without the integration of human dignity as a fundamental principle, any form of development risks becoming inequitable and, ultimately, unsustainable.

In order to understand and assess whether an economic activity respects human dignity, a three-dimensional normative model is proposed, based on the fulfillment of three essential normative conditions: real autonomy, non-instrumentalization and ensuring a minimum level of well-being. The choice of these conditions is not arbitrary, but stems from philosophical traditions and the foundations of sustainable development.

The first normative dimension is the condition of real autonomy. It has its foundation in both Kantian ethics and in the capabilities theory developed by Amartya Sen. From a Kantian perspective, autonomy represents the individual's capacity to act according to his own rational will. A. Sen emphasizes "capabilities", understanding freedom not only as the absence of formal constraints, but as the existence of real and effective options. And therefore, the individual's participation in economic life must be the result of free and informed consent, not of economic constraints. This requires that people have real alternatives, access to education, social protection, employment options.

The second dimension is that of non-instrumentalization. It is based on the imperative formulated by Immanuel Kant, according to which the person must always be treated as an end in itself and never merely as a means to maximize profit or economic efficiency. Economic practices become amoral when they completely ignore the intrinsic value of the person. The use of human capacities in economic processes is inevitable, but it becomes problematic when the person is reduced exclusively to the status of a resource, a factor of production or a cost.

And the third normative dimension is the condition of integrity and minimum well-being. This is based on the theory of capabilities and the normative framework of sustainable development, reflected in the Sustainable Development Goals promoted by the United Nations. This dimension goes beyond strictly utilitarian approaches to well-being and emphasizes the real conditions that allow a dignified life: economic security, safe working conditions, access to health and education. And so, well-being is not reduced to income, but is understood as a set of conditions that support the exercise of autonomy and social participation.

The proposed model distances itself from traditional approaches that evaluate development only in terms of material resources or collective utility. Compared to the theory of capabilities, which provides a general framework for analysis, this model has a clearer normative function: it serves as an ethical evaluation tool for real economic practices. At the same time, unlike the utilitarian view, the model imposes moral limits. This means that no increase in economic efficiency or general welfare can be used as an argument to justify the sacrifice of individual rights.

To increase the empirical applicability of the model, each dimension is operationalized through an evaluation scale structured on three levels:

1. Real autonomy

- Low: the individual has no real alternatives; lack of other work options.

- Medium: there are limited options, but these are restricted by structural factors, such as, for example, education.
- High: the individual has access to real alternatives and can make decisions in conditions of freedom.

2. Non-instrumentalization

- Low: the person is treated exclusively as a means, substitutable labor force, lack of institutional respect.
- Medium: there are some protection mechanisms, but economic logic dominates the relationship, partial respect for dignity.
- High: the person is recognized as an end in himself, being actively respected within economic relations, enjoys fair treatment.

3. Well-being and integrity

- Low: precarious working conditions, insufficient income for a decent living, risks to health and safety.
- Medium: acceptable conditions, but insufficient for a stable and secure life in the long term.
- High: conditions compatible with a decent life, social protection, safe working conditions are ensured.

Lack of one of these dimensions or a low assessment on one of them indicates a total or partial incompatibility with the demands of human dignity. In this sense, the proposed model does not only aim to describe economic realities, but also provides a normative framework for their evaluation and orientation, contributing to the effective integration of human dignity into the paradigm of sustainable economic development.

In Table 1, *Matrix for assessing economic activity from the perspective of respecting human dignity*, it can be seen how the model can be applied to economic activities, using three main questions. A high level of assessment shows that the economic activity is compatible with human dignity. A medium level indicates that there are some ethical problems and the compatibility of the economic activity with human dignity is compromised. A low level indicates the existence of serious ethical problems and a lack of respect for human dignity.

Table 1. Matrix for evaluating economic activity from the perspective of respecting human dignity

Dimension	Key Rating Question	Low	Medium	High
Autonomy	To what extent do the people involved have real freedom of choice in participating in economic activity?	Lack of real options/ alternatives	Limited options	Real freedom of choice
Respect, non-instrumentalization	To what extent are people treated as ends in themselves, and not exclusively as a means to achieve economic objectives?	Is treated as a mere means	Partial respect	Is treated as an end in itself
Well-being	To what extent are living and working conditions compatible with a dignified existence ensured?	Precarious conditions	Acceptable conditions	Decent and safe conditions

Source: prepared by the author

The final assessment is made by analyzing the three dimensions. The presence of a low level indicates a significant impairment of respect for human dignity in the economic activity analyzed.

We aimed to apply this model to the economic activity of the fast fashion industry. The specialized literature highlights the fact that the fast fashion industry generates significant social and environmental costs.

The study by Bick et al. (2018) shows that low wages and poor working conditions disproportionately affect workers in low-income countries. The fast fashion industry is associated with low wages, health and environmental impacts. (Bick, Halsey, & Ekenga, 2018). The authors argue that in the decades since the fast fashion business model became the norm for big-name fashion brands, increased demand for large amounts of inexpensive clothing has resulted in environmental and social degradation along each step of the supply chain. They argue that “from the growth of water-intensive cotton, to the release of untreated dyes into local water sources, to worker’s low wages and poor working conditions; the environmental and social costs involved in textile manufacturing are widespread”. (Bick, Halsey, & Ekenga, 2018).

The precarious situation in the fast fashion industry is also highlighted by researcher A. Joselin. She mentions that fast fashion and sweatshops are intricately linked within the global fashion industry. Fast fashion brands often prioritize profit over ethical production (Joselin, 2024).

In order to evaluate the economic activity in the fast fashion industry, the three conditions set forth are observed. So, the first condition is that of real autonomy. The question that arises here is: To what extent do the people involved have real freedom of choice in participating in the economic activity? The answer in our case is: quite low. Workers in South Asia and Africa, where the production of fast fashion items is often concentrated, have limited options, there are few real alternatives for employment. The evaluation indicates a low-medium level.

Examining the fast fashion industry through the lens of the second condition, that of non-instrumentalization, the question arises: To what extent are people treated as ends in themselves, and not exclusively as means to achieving economic objectives? Studies on this topic reveal that workers in this industry are treated almost exclusively as means. The emphasis is on minimum costs and fast production. Workers are treated, rather, as cheap labor and are constantly pressured to increase labor productivity. The assessment indicates a low level.

The third normative condition is the condition of integrity and minimum well-being. The following question is asked: To what extent are living and working conditions compatible with a dignified existence ensured? The general answer is: low level. Wages for workers in the fast fashion industry are very low, working conditions are often precarious, there are risks to health and safety. For example, "Bangladesh's minimum salary for textile workers is only \$94 per month, far less than the estimated \$569 per month living wage". The assessment reveals a low level. The results of the assessment can be seen in Table 2, *Assessment of economic activity in the fast-fashion industry from the perspective of respect for human dignity*.

The assessment indicates a generally low level of compatibility with human dignity in the fast fashion industry, in particular from the perspective of respect for the person and the well-being of workers.

Table 2. Evaluation of economic activity in the fast-fashion industry from the perspective of respecting human dignity

Dimension	Key Rating Question	Evaluation, level
Autonomy	To what extent do the people involved have real freedom of choice in participating in economic activity?	Low-Medium
Respect, non-instrumentalization	To what extent are people treated as ends in themselves, and not exclusively as a means to achieve economic objectives?	Low
Well-being	To what extent are living and working conditions compatible with a dignified existence ensured?	Low

Source: prepared by the author

Based on the results of the assessment, the need for interventions aimed at reducing the gap between existing economic practices and the demands of human dignity is outlined. It is necessary to strengthen the framework for labor regulation at national and international levels, in order to ensure safe working conditions and remuneration that allows a decent living. It is necessary to increase transparency in supply chains. Consumers must have access to relevant information on production conditions. Public policies must aim to expand the real capabilities of workers, through investments in education, social protection and the diversification of employment opportunities.

Thus, the analysis demonstrates that the integration of human dignity into the contemporary economy is not just an abstract ethical requirement, but a practical necessity for achieving truly sustainable economic development.

5. Conclusions

Sustainable economic development cannot be reduced to economic growth or technical efficiency. It involves the integration of fundamental ethical principles, among which human dignity occupies a central place.

The analysis carried out highlights the fact that human dignity is not just an abstract ideal, but an essential normative criterion for the evaluation and orientation of economic activities. In the context of the contemporary economy, characterized by globalization, competition and pressure on costs, the risk of instrumentalizing the individual is becoming increasingly pronounced. From this perspective, the Kantian principle of treating the person as an end in itself acquires particular relevance. Integrating dignity into the economy does not imply the elimination of market mechanisms, but their orientation and regulation in such a way as to respect the intrinsic value of the individual. At the same time, sustainable development must be understood as a complex process, which includes economic, social and ecological dimensions, but which finds its ethical foundation in respecting human dignity.

In this context, an evaluation model based on three fundamental dimensions has been proposed: real autonomy, respect (non-instrumentalization) and minimal well-being. This model allows a normative analysis of the compatibility of economic activities with respect for human dignity.

Therefore, an economy can only be considered truly sustainable to the extent that it focuses on the individual as the ultimate goal and contributes to the expansion of human freedoms and the assurance of a dignified life for all individuals, both now and for future generations.

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THE IMPACT OF DIGITALISATION ON ECONOMIC SECURITY AND THE EFFECTIVENESS OF COMPANY DEVELOPMENT MANAGEMENT

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Abstract: *The article examines the impact of digitalisation processes on the economic security of enterprises and the effectiveness of company development management. It considers the main advantages of introducing digital technologies into the activities of enterprises, as well as the risks that arise in the process of digital business transformation. The role of information security in ensuring the stable functioning of companies in today's globalised environment is determined. It is substantiated that the effective use of digital technologies contributes to increasing the competitiveness of enterprises, optimising business processes and forming a modern system of company development management. The paper analyses the main areas of influence of digitalisation on the activities of enterprises, in particular on improving management efficiency, labour productivity, cost optimisation and market expansion. Particular attention is paid to the analysis of risks arising in the process of digital transformation, including cyber attacks, leakage of confidential information, technical failures of information systems, and the dependence of enterprises on digital infrastructure. It is proven that in the context of the active development of digital technologies, an important element of strategic enterprise management is the formation of an effective system of economic and information security. The article also examines the impact of digital technologies on strategic planning processes, the organisation of management processes and management decision-making. It is emphasised that the use of modern information and analytical systems contributes to improving management efficiency, improving the coordination of structural units and the formation of new business models. From the perspective of microeconomic analysis, it is determined that digitalisation contributes to reducing transaction costs, increasing the efficiency of resource use, and strengthening the competitive positions of enterprises. The need to improve risk management mechanisms and introduce modern tools to ensure the economic security of enterprises in the digital economy is substantiated.*

Keywords: *Digitalisation, economic security, information security, company development management, digital transformation, enterprise, competitiveness.*

Classification JEL: O33, M15, L25, D23, G32.

UDC: 004:[338.1+005] **DOI:** <https://doi.org/10.53486/ser2026.14>

1. Introduction

In the current conditions of global economic development, digitalisation is becoming one of the key factors in the transformation of the business environment. The active introduction of

digital technologies is changing traditional approaches to the organisation of production, enterprise management and interaction with the external environment. Enterprises are increasingly using digital platforms, information systems, process automation and other innovative tools to improve the efficiency of their activities.

At the same time, digitalisation creates not only new opportunities for companies to grow, but also new challenges and risks related to ensuring economic and information security. Breaches of information security, cyberattacks, leaks of commercial information, or dependence on digital infrastructure can negatively affect the stability of enterprises.

In this regard, it is particularly important to study the impact of digitalisation on the economic security of enterprises and the effectiveness of company development management, which allows for the formation of effective mechanisms for adapting businesses to the current conditions of the digital economy.

2. Literature Review

The problems of economic security of enterprises and the impact of digitalisation on business development have been studied by many domestic and foreign scientists. In particular, the works of Baranovsky (2014) reveal the theoretical foundations of economic and financial security and substantiate its role in ensuring the stable functioning of enterprises and the national economy. The theoretical foundations of economic security of enterprises are also considered in the works of Ukrainian researchers Blank (2004) and Kozachenko et al. (2003), who studied the mechanisms for ensuring the financial and economic stability of enterprises. The issues of forming an enterprise economic security system and threat management are also analysed in the scientific works of Vasylytsiv et al. (2012), which examine tools for improving the economic stability of economic entities. Contemporary aspects of the development of enterprise economic security systems in the context of digitalisation and economic transformation are studied by Andriiv (2023), Zubko (2022), Zhadko and Samoilenko (2020), and Rudnichenko et al. (2024), who consider new threats to the functioning of enterprises, in particular information risks, cyber threats and the dependence of business on digital infrastructure.

Foreign scientists have made a significant contribution to the study of the impact of digitalisation on business development. In particular, Brynjolfsson and McAfee (2014), in their work "The Second Machine Age," explore the impact of digital technologies on productivity, cost structure and competitiveness of companies. The issues of digital business transformation and its impact on enterprise management are addressed in the studies by Westerman et al. (2014), who analyse the role of digital technologies in improving the efficiency of management processes.

The problems of digital transformation of organisations are also explored in the works of Vial (2019), which examines the mechanisms of digitalisation's impact on business models. The issue of integrating digital technologies into corporate strategy is analysed in a scientific article by Bharadwaj et al. (2013), dedicated to the formation of a digital business strategy.

At the same time, scientific research pays considerable attention to issues of cybersecurity and the protection of enterprises' information resources. In particular, Anderson (2008), in his work Security Engineering, examines mechanisms for ensuring information security and managing cyber risks in the digital environment.

The issues of forming the structure of an enterprise's economic security, its functional components and risk management are also covered in the works of Zybareva and Burachok (2025), which examine the factors of economic security of enterprises and identify strategic directions for its strengthening in the context of modern economic transformations.

Despite a significant amount of scientific research in this area, the issues of comprehensive analysis of the impact of digitalisation on the economic security of enterprises and the effectiveness of company development management remain insufficiently studied and require further scientific research.

3. Methodology

The study of the impact of digitalisation on economic security and the effectiveness of company development management was carried out using methods of theoretical generalisation, analysis and synthesis of scientific sources. In the course of the research, scientific works by domestic and foreign scientists devoted to the problems of economic security of enterprises, digital transformation of business, information security and management of company development were studied.

The research process consisted of several stages:

- analysis of scientific publications on the issues of economic security of enterprises, digitalisation of business and management of company development;
- systematisation of theoretical approaches to defining the essence of economic and information security of enterprises in the digital economy;
- summarising the results of research on the impact of digital technologies on the effectiveness of enterprise management, the level of competitiveness and economic stability of companies;
- comparative analysis of scientific approaches to assessing the risks of digitalisation and identifying areas for improving the economic security of enterprises.

The application of these research methods made it possible to comprehensively examine the impact of digitalisation on the economic security of enterprises and determine its role in improving the effectiveness of company development management in the modern digital economy.

4. Results and Discussion

Digitalisation is one of the key areas of development in the modern economy. It involves the use of digital technologies in various areas of enterprise activity, including production, management, marketing, logistics and finance (Westerman et al., 2014). The introduction of digital technologies contributes to the optimisation of business processes, increased labour productivity and reduced costs (Bharadwaj et al., 2013).

As can be seen from Table 1, the introduction of digital technologies creates significant opportunities for business development. In particular, digitalisation contributes to improving management efficiency, optimising costs and improving customer interaction.

One of the important aspects of digitalisation is its impact on the economic security of a business. The economic security of a company is seen as the protection of its resources, interests, and development potential from internal and external threats. In today's world, a lot of these threats are linked to the digital environment.

Table 1. Key benefits of digitalisation for enterprise development

Area of impact	Characteristic
Improved management efficiency	The use of information systems allows for rapid data analysis and management decision-making
Cost optimisation	Process automation reduces production and management costs
Increased labour productivity	The use of digital technologies speeds up production and management operations
Expansion of sales markets	Internet platforms and e-commerce enable companies to enter new markets
Improved customer interaction	The use of CRM systems and online communications improves service quality

Source: developed by the authors

The use of digital technologies allows enterprises to improve the efficiency of business process management. Thanks to the automation of information processing, company management can quickly obtain the data necessary for making management decisions. This contributes to a more rational use of resources, cost optimisation and increased competitiveness of the enterprise (Brynjolfsson & McAfee, 2014).

At the same time, digitalisation creates certain risks for the economic security of a company. Among the main threats are cyber attacks, leakage of confidential information, disruption of information systems, and the dependence of the enterprise on digital infrastructure. Such risks can lead to financial losses, loss of business reputation and a decrease in the efficiency of the enterprise (Vial, 2019).

Table 2. Main risks of digitalisation for the economic security of an enterprise

Type of risk	Characteristics
Cyber threats	Unauthorised access to information systems, hacker attacks
Information leakage	Disclosure of commercial or confidential information
Technical failures	Disruption of servers, software or information systems
Dependence on IT infrastructure	Business process downtime in the event of technical problems
Insufficient staff training	Employee errors when using digital technologies

Source: developed by the authors

The data in Table 2 show that, along with its positive effects, digitalisation poses new threats to the economic security of enterprises. Therefore, an important task for management is to develop an effective information security and risk management system.

A conceptual model of the impact of digitalisation on economic security and the effectiveness of enterprise development management is presented in Figure 1.

In this regard, an important task for company management is to develop an effective information security system. This includes a set of organisational, technical and legal

measures aimed at protecting the enterprise's information resources from unauthorised access, damage or loss (Tulchynska et al., 2021).

Effective management of a company's development in the context of digitalisation involves the use of modern information technologies for planning, controlling and analysing the enterprise's activities. Digital tools enable company management to respond quickly to changes in the market environment, assess risks and make strategic decisions regarding the development of the enterprise.

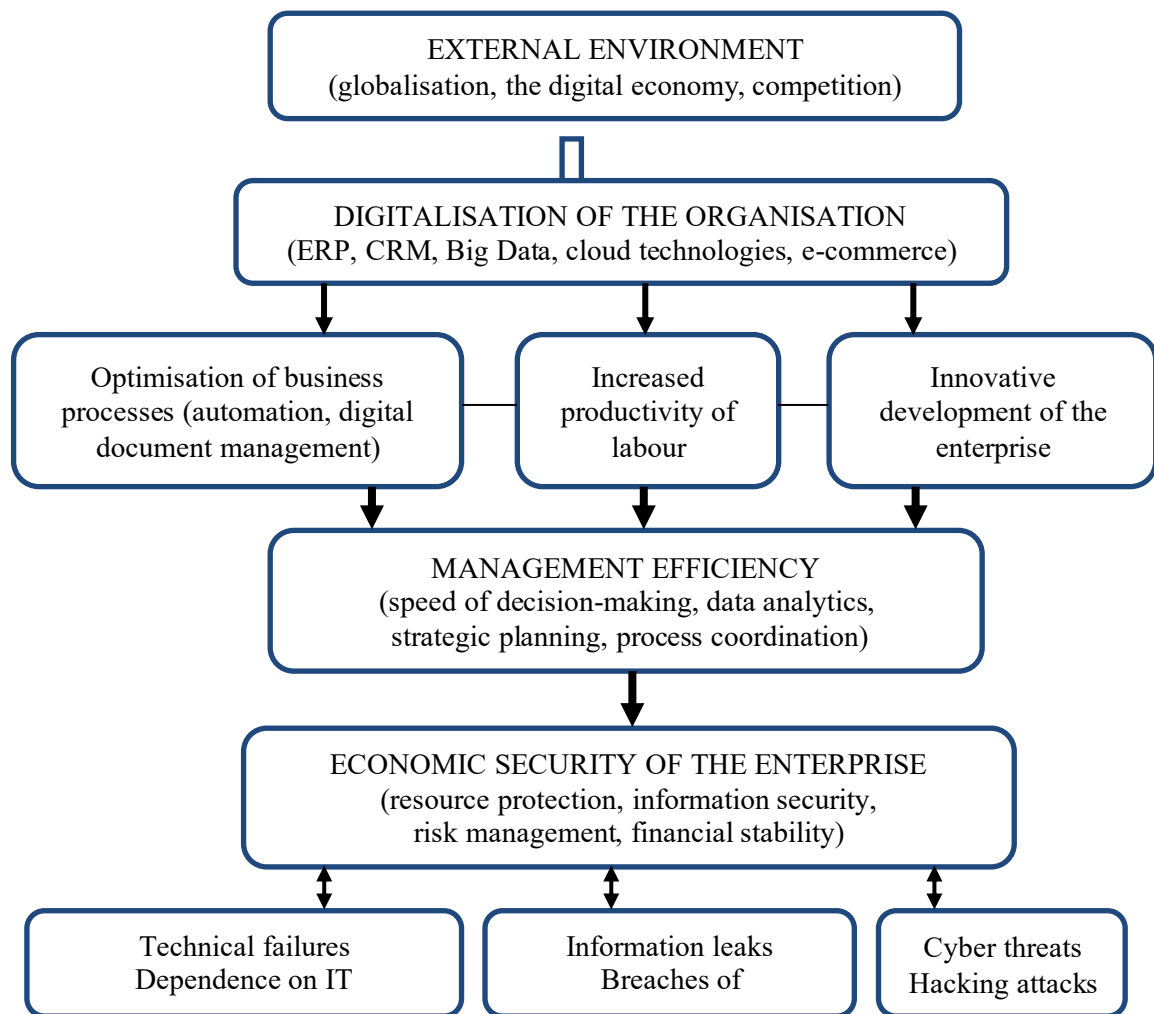


Figure 1. Conceptual model of the impact of digitalisation on economic security and the effectiveness of enterprise development management

Source: developed by the authors

In addition, digitalisation contributes to the improvement of the company's strategic planning system. The use of modern information and analytical systems allows the company's management to conduct a comprehensive analysis of the internal and external environment, assess the efficiency of resource use and identify potential threats in a timely manner. This ensures more informed management decisions and the formation of long-term strategies for the company's development (Rudnichenko et al., 2024).

Another important aspect is the impact of digital technologies on the organisation of management processes. Thanks to the introduction of electronic document management, automated management systems and digital platforms, the speed of information exchange between structural units of the enterprise is increasing. This contributes to more effective coordination of activities, reduction of management costs and increased responsiveness to changes in market conditions.

At the same time, digitalisation stimulates the innovative development of enterprises and the formation of new business models. The use of digital technologies opens up opportunities for the introduction of innovative products and services, the expansion of sales channels and the improvement of customer interaction. As a result, enterprises gain additional competitive advantages, which has a positive impact on their economic stability and prospects for further development (Zubko, 2022).

From the point of view of microeconomic analysis, digitalisation affects the structure of an enterprise's costs, labour productivity, resource efficiency and competitiveness. Enterprises that actively implement digital technologies have the opportunity to reduce transaction costs, improve product quality, and expand sales markets. At the same time, the effective use of digital technologies requires an appropriate level of staff training, investment in the development of information infrastructure, and the formation of a modern risk management system.

Thus, digitalisation is an important factor in improving the effectiveness of company development management. It creates new opportunities for innovative development of enterprises, but at the same time requires an adequate level of economic and information security.

5. Conclusions

Therefore, digitalisation is an important factor in the development of modern enterprises and has a significant impact on the effectiveness of company management. The use of digital technologies contributes to the optimisation of business processes, increased labour productivity, reduced costs and strengthened competitive positions of enterprises in the market.

At the same time, digitalisation processes create new challenges for the economic security of enterprises, particularly in the area of information resource protection and digital risk management. In this regard, an important task for modern companies is to develop an effective information and economic security system that will minimise potential threats and ensure the stable development of the enterprise.

Further research in this area could focus on developing practical mechanisms for improving the economic security of enterprises in the process of digital business transformation.

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ANALYSIS OF THE REGULATORY FRAMEWORK ON SUSTAINABILITY REPORTING

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Abstract: *A corporation's ability to occupy and maintain a respectable position in the global market has a positive impact not only on its image, but also on its country's standing internationally. At the same time, globalization trends increase competition, which can lead to a number of negative phenomena affecting both the sustainable development of corporations and the development of countries and the global community as a whole. In this regard, provisions relating to corporate sustainability reporting are of particular importance. This article analyzes the stages of development of a sustainable economy and examines regulatory acts in the field of sustainable development and related reporting. It considers the problems and difficulties of introducing or applying reporting by corporations. It also examines the problems of applying sustainable development reporting in the Republic of Moldova and proposes ways to solve these problems.*

Keywords: sustainability reporting, standards, GRI, ESRS standards.

JEL Classifications: M49, M19, M29.

UDC: 005.35:502.131.1 **DOI:** <https://doi.org/10.53486/ser2026.15>

1. Introduction

Currently, corporate responsibility indicators are one of the factors that should be taken into account when making investment decisions. This is primarily due to numerous scandals in the field of corporate governance (Enron, Parmalat, etc.), corporate bankruptcies, and the environmental crisis. These circumstances, on the one hand, undermined the trust of society and investors, and on the other hand, led to the need to obtain more complete, reliable and transparent information from corporations. All this has led to the need to compile and provide sustainability reports.

Initially, corporations provided this information on a voluntary basis to demonstrate their openness and provide more complete non-financial information to users of financial statements. Subsequently, the approach to non-financial reporting became more structured, and currently 96% of the world's 250 largest corporations (G250) publish sustainability reports.

2. Literature Review

Analyzing specialized literature on sustainable development, it should be noted that the main emphasis is placed on disclosing indicators that must be presented in sustainable development reports. For example, in his work "Sustainability Indicators and Sustainability Performance Management," Professor A. Warhurst of the University of Warwick, UK, notes that: "Despite the apparent vagueness of the term, indicators have been widely used for monitoring and assessing numerous environmental impacts of operations, and are increasingly used in the social and economic arenas." (Warhurst, 2002) At the same time, it should be noted that environmental pollution indicators are currently the most relevant. If we examine environmental pollution indicators on the Numbeo website, (Index, 2025) it is noteworthy that southeastern Europe is the most polluted.

Table 1. Europe: Pollution Index by Country 2025 Mid-Year

Rank	Country	Pollution Index	Exp Pollution Index
1	North Macedonia	79.2	144.1
2	Monaco	78.2	140.2
3	Albania	77.3	135.5
4	Malta	75.7	132.7
7	Ukraine	62.2	107.1
8	Moldova	60.5	104.4
38	Estonia	16.9	27.1
39	Iceland	16.7	27.9
40	Finland	11.7	19.6

Source: Numbeo https://www.numbeo.com/pollution/rankings_by_country.jsp?title=2025-mid&region=150

In his work “Sustainability indicators and indices: an overview,” (Wu, 2012) Wu J examines the interrelationship between three main blocks of indicators: economic, social, and environmental. He notes that for the relationship to be sustainable, it must be based on the economy, which is included in the social sphere, which in turn is reflected in the environmental indicator.

It should be noted that in its normative act Indicators of sustainable development: guidelines and methodologies, the United Nations establishes four groups of sustainable development indicators that will help countries and governments develop their sustainable development programs. (Nations., 2001)

Table 2: DSR Framework for Sustainable Development Indicators

SD Dimension	State Indicators
Social	Education, Employment, Health/water supply/sanitation, Housing, Welfare and quality of life, Cultural heritage, Poverty/Income distribution, Population, Social and ethical values, Role of women, Access to land and resources, Community structure.
Economic	Economic dependency/Indebtedness/ODA, Energy, Consumption and production patterns, Waste management, Transportation, Mining, Economic structure and development, Trade, Productivity.
Environmental	Freshwater/groundwater, Agriculture/secure food supply, Urban, Coastal Zone, Marine environment/coral reef protection, Fisheries, Biodiversity/biotechnology, Sustainable forest management, Air pollution and ozone depletion, Global climate change/sea level rise, Sustainable use of natural resources, Sustainable tourism, Restricted carrying capacity, Land use change.
Institutional	Integrated decision-making, Capacity building, Science and technology, Public awareness and information, International conventions and cooperation, Governance/role of civic society, Institutional and legislative frameworks, Disaster preparedness, Public participation.

Source: UN <https://www.un.org/esa/sustdev/natlinfo/indicators/isdms2001/isd-ms2001isd.htm>

It should be emphasized that some of the indicators in this table can also be used by corporations for sustainability reporting. However, there are no approved, unified standards at the global level that are mandatory for all corporations. Currently, there are various sustainability indicators developed by various public and private organizations that can be used by absolutely all companies in their reporting.

According to the definition of the UN World Commission on Environment and Development, sustainable development is «the satisfaction of the needs of today, which does not deprive future generations of the opportunity to satisfy their own needs».

The United Nations' 2025 Sustainable Development Goals Report notes that it has been 10 years since world leaders adopted a transformative agenda across a significant area of development, reaching 2030. (United Nations) During this period, the world has transformed significantly: internet access has increased by 70 percent, women now hold 27 percent of parliamentary seats worldwide, and access to green energy has expanded. However, clear development threats are emerging: conflict, climate chaos, geopolitical instability, and sudden shocks continue to impede progress at the pace and scale needed to achieve the 2030 goals. The 2025 Development Goals Report shows that only 35 percent of goals are on track, and 18 percent are being set with the opposite effect. Meanwhile, debt servicing costs in low-income countries are reaching a record \$1.4 trillion, limiting the resources needed for development.

3. Methodology

When writing this scientific article, the author used a research approach based on analysis and synthesis. United Nations regulatory documents on the methodology for calculating and presenting sustainable development indicators were analyzed. The study analyzed relevant scientific literature and articles in the field of indicators presented in integrated reporting.

The methodological approach is aimed at analyzing regulatory documents and scientific literature on the subject, identifying trends and key indicators necessary for integrated reporting, and proposing a comparative approach to different contexts of integrated reporting.

This study is based on general scientific and special methods of cognition of socio-economic processes and phenomena, in particular, methods such as deduction, induction, and scientific abstraction were used.

4. Results and Discussion

Information on sustainable development of an enterprise can be presented both in integrated reporting and in separate reports. Sustainable development represents a balance between the economic, social, and environmental development of an enterprise. The economic decisions made by a company can have a significant impact on the environment and society. Sustainable development of a company should contribute to the creation of systems that preserve natural resources and reduce negative impacts on the environment. A distinctive feature of the advanced development of companies in the modern economy is the emergence of so-called ecosystems, such as the Netflix ecosystem and others.

The need for sustainability reporting was first justified in the mid-20th century by Greenpeace as a requirement for transparency in corporate environmental impacts. Thus,

beginning in the mid-20th century, a number of companies began publicly disclosing information about their environmental impact. Initially, particular attention was paid to environmental issues, such as carbon emissions, water use, and waste disposal. Subsequently, reports began to include a broader range of aspects, such as social and economic ones. Sustainability reporting required the development of specific indicators and standards for unify them.

There are several sustainability reporting standards that are popular among organizations and businesses. Some of the most common standards and platforms for sustainability reporting are the Global Reporting Initiative (GRI), the Sustainability Accounting Standards Board (SASB), and the International Organization for Standardization (ISO).

Global Reporting Initiative (GRI) is one of the very first sustainability reporting platforms. It offers recommendations on topics such as human rights, HR practices, and corporate governance. Due to its complexity, GRI is commonly used by medium and large organizations.

The Sustainability Accounting Standards Board (SASB) standard was elaborated in 2011 with a focus on the financial implications of sustainable development; in other words, it focuses primarily on how an organization's commitment to sustainable development practices affects its profitability. This standard provides 13 accounting indicators for each industry that can be used for accurate reporting on the organization's performance.

International Organization for Standardization (ISO) standards such as 14001:2015 and 26000:2010 are designed to provide guidance on environmental management systems and corporate social responsibility (CSR) systems, respectively. These standards cover topics such as human rights, human resource practices, environmental protection, product safety and quality control, and fair labor practices.

The United Nations has issued the following standards:

- SDG 6 Standards: Clean Water and Sanitation;
- SDG 7 Standards: Affordable and Clean Energy;
- SDG 11 Standards: Sustainable Cities and Communities;
- SDG 13 Standards: Climate Action.

In turn, the EU's regulatory and legislative framework for sustainable development is represented by the following regulatory acts:

- **The European Green Deal** - a plan to achieve net-zero greenhouse gas emissions and zero total environmental pollution by transitioning from fossil fuels to renewable energy and raw materials in European Union member states by 2050;
- **Directive (EU) 2022/2464**, CSRD (Corporate Sustainability Reporting Directive), of the European Parliament and of the Council of 14 December 2022 as regards corporate sustainability reporting;
- **Regulation (EU) 2019/2088** of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector (SFDR);

- **Regulation (EU) 2020/852** of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088, known as the EU Taxonomy.

The European Central Bank, acting as the direct supervisory authority for the largest banks in the eurozone, and the European Banking Authority (EBA) have placed climate and environmental risk management at the center of their agenda.

On July 31, 2023, the European Commission adopted the European Sustainability Reporting Standards (ESRS) for use by all companies subject to the Corporate Sustainability Reporting Directive (CSRD).

The ESRS is a set of technical standards developed by the European Financial Reporting Advisory Group (EFRAG) to support the implementation of the CSRD and covers various environmental, social, and governance (ESG) aspects, including climate change, pollution, biodiversity, labor conditions, human rights, and more.

The ESRS are part of Directive (EU) 2022/2464, the CSRD, and their primary objective is to provide a simpler, more transparent, and more logical structure for information in sustainability reports. (Directive (EU) 2022/2464)

There are currently 12 comprehensive ESRS standards, with others in development:

- 2 cross-cutting standards on general topics containing basic principles,
- 10 specific standards covering environmental (E1–E5), social (S1–S4), and governance (G1) topics.

Voluntary Sustainability Reporting Standard (VSME) for Non-Listed Micro, Small, and Medium Enterprises. It is a framework developed by the European Financial Reporting Advisory Group (EFRAG) to help smaller companies in the EU report on their sustainability and ESG (Environmental, Social, and Governance) performance.

The VSME (Reporting) standard is intended to be less complex than the CSRD/ESRS. It contains far fewer data points and follows the "if applicable" principle, meaning that firms only need to report in areas that are relevant to their specific operations.

Modular Structure: The standard is divided into two modules:

- *Basic Module*: This is the fundamental level, ideal for businesses that are just starting out with sustainability reporting. It covers essential metrics such as energy consumption, greenhouse gas emissions, and workforce data.
- *Comprehensive Module*: This module builds on the basic module with additional information that may be requested by financial institutions and investors.

Analyzing the Republic of Moldova's regulatory and legislative acts pertaining to sustainability reports, it is worth noting that Article 23, "Management Report," of Law No. 287 of December 15, 2017, "On Accounting and Financial Reporting" stipulates that medium-sized, large, and public-interest entities annually prepare and submit a management report along with their financial statements. The management report includes, at a minimum, information on environmental protection and employee professional development. (Law No. 287 of December 15)

The report of the management of the public interest entity of the Republic of Moldova, whose securities are admitted to trading on the regulated market, includes a section on corporate governance, which should contain information on:

- the corporate governance code applied by the entity with reference to the source of its publication;
- the degree of compliance of the entity with the provisions of the corporate governance code and in case of deviations from them, explanations for the parts of the code that they do not apply, and the reasons for non-application;
- the entity's internal control and risk management systems in relation to the financial reporting process.

A large entity and a public interest entity of the Republic of Moldova that is a mining industry or a forest management company include in the management's report a separate chapter on payments to the state, containing amounts paid in cash or in kind, in the form of fees for natural resources, income tax, royalties, dividends, license fees, if at least one of these payments exceeds 1,700,000 lei in the reporting period.

On June 2023 the International Sustainability Standards Board (ISSB) published its first two International Sustainability Disclosure Standards (IFRS /SDS or the Standards) that become effective for periods beginning on or after 1 January 2024:

1. *IFRS S1 "General Requirements for Disclosure of Sustainability-related Financial Information,,;*
2. *IFRS S2 "Climate-related Disclosures".*

The International Auditing and Assurance Standards Board (IAASB) has taken a significant step forward in sustainability reporting with the approval and issuance of the International Standard on Sustainability Assurance (ISSA) 5000, General Requirements for Sustainability Assurance Engagements, effective for periods beginning on or after December 15, 2026,

The ISSO 5000 framework is based on the ESG (environment, social responsibility, governance) framework, a set of standards used by companies and investors to evaluate the effectiveness and level of compliance with sustainability policies regarding environmental, social, and governance impacts: (5000)

Environmental: Describes how a company manages its environmental impact. This includes policies related to carbon emissions, natural resource use, waste management, etc.

Social: Describes a company's relationships with employees, the local community, and society at large. This aspect includes practices related to diversity and inclusion, fair labor practices, contributions to community development, etc.

Governance: Describes the management structure and how the company governs itself. This includes aspects such as transparency, business ethics, legal compliance, board independence, etc.

A company's disclosure of information on such matters may relate to several different topics (e.g., climate, labor practices, biodiversity) and aspects of the topics (e.g., risks and opportunities, indicators, and key performance indicators). Legislation, regulations, or reporting systems in the field of sustainable development may describe sustainability issues, topics, or aspects of topics in different ways, and may also contain requirements or

recommendations for an organization in determining the information on sustainable development to be provided.

Examples of topics and aspects of topics include the following:

- Environment (Climate, including emissions, Energy, for example, type of energy and consumption, Water and wastewater, such as water consumption and water discharge, Biodiversity, for example, impacts on biodiversity or protected and restored habitats),
- Social issues (Work practices such as diversity and equal opportunities, vocational training and education, and occupational health and safety, Human rights and public relations, such as community engagement, impact assessment, and development programs, Customer health and safety), Governance (Monitoring, management and oversight of sustainable development issues and related impacts).

Information on sustainable development is provided in accordance with criteria that are fixed in law or regulations or established by authorized or recognized organizations that follow a transparent due process. In different countries, information on sustainable development is presented in accordance with different rules, which must necessarily be confirmed, or in some jurisdictions, regulations may require that only climate-related information disclosure in the sustainable development information of an enterprise be subject to verification.

Thus, the sustainability information provided by a corporation may be limited to certain aspects, such as selected indicators, targets, or key performance indicators. Alternatively, sustainability information may cover a variety of different aspects, as required by a sustainability reporting framework, legislation, or regulations, or as the organization chooses to provide voluntarily.

Sustainability information may be presented in various ways, such as in a stand-alone sustainability report issued by the company, as part of an annual report (e.g., a separate report in the annual financial report, or as part of the management report or management commentary), in an integrated report, or in a supplement to the financial statements or management report. Depending on the applicable criteria, sustainability information may relate to an individual company or may include information about companies within a group or other companies in the reporting company's value chain.

The role of information technology in sustainability reporting should also be considered, as some sustainability solutions help corporations accurately and effectively track progress toward their ESG goals. For example, cloud solutions (Microsoft Cloud for Sustainability) help corporations unify data analysis, create a resilient IT infrastructure, logical value chains, and reduce the environmental impact of their operations. Overall, cloud computing is a sustainable technology because moving workloads from on-premises to the cloud can reduce emissions by up to 98%.

The use of information technology (IT) helps streamline processes often involved in creating sustainability reports, such as sorting relevant data sets to improve analysis efficiency. This is especially necessary when analyzing large volumes of data or complex information, which can be time-consuming to sort manually. Microsoft Azure and Microsoft 365 cloud services enable monitoring the impact of emissions, helping to assess carbon emissions and the reductions already achieved.

IT not only helps corporations improve the accuracy of their reporting but also provides reliable evidence for third-party audits, such as those required by the GRI platform. It's worth

noting that the use of IT assists corporations in preparing sustainability reports and offers numerous benefits. Corporations can use technology to track the environmental impact of their actions, assess opportunities in operational processes and product lifecycles, and develop strategies to reduce emissions and improve environmental conditions.

5. Conclusions

Sustainability reporting is an important aspect of corporate sustainability, as it helps stakeholders and customers better understand the progress of ESG initiatives. However, there are several challenges associated with the implementation and use of sustainability reporting, primarily the difficulty in determining which factors should be disclosed and published. There are different opinions on what should be included in sustainability reporting. Some companies may focus on environmental issues such as carbon emissions or water consumption, while others focus on social indicators. This makes it difficult to compare different companies in terms of their overall environmental or social responsibility.

Another important issue in reporting and disclosure remains the methodology for calculating specific indicators across various industries. To accurately measure progress over time and compare itself with competitors, corporations must use consistent methodologies when collecting data and creating sustainability reports. Clearly, not all corporations use the same method for collecting and analyzing data, and revising individual methods can be labor-intensive and resource-intensive. Therefore, the need arises for a unified regulatory framework for sustainability reporting. Universal standardization will require a large-scale oversight program to closely monitor and ensure compliance. This will ensure accurate reporting and prevent organizations from manipulating results or data to create the appearance of a favorable ESG profile. However, implementing such a program requires many years and significant resources.

The benefits of implementing ESG standards and developing sustainability reporting for corporations include:

- Wider access to financing, investment, and new business opportunities,
- Improved corporate reputation,
- Reduced operational risks,
- Improved business decision-making,
- Strengthened brand reputation,
- Achieve a competitive advantage in the marketplace,
- Increased operational efficiency and cost reduction,
- Improved communication with external stakeholders.

Analyzing the procedure for applying sustainability reporting at the global level, it should be noted that there are certain challenges that an enterprise in the Republic of Moldova may face when applying ESG standards and compiling a sustainability report, namely:

1. The nascent regulatory framework and the complexity of transposing the acquis Communautaire;

2. Lack of an operational national Taxonomy and the risk of “Greenwashing”;
3. Lack of credible and standardized ESG data;
4. Limited technical capacity and expertise at all levels;
5. Implementation costs and limited access to sustainable finance;
6. Low awareness and market pressure.

For more effective implementation of sustainable development reporting provisions in the Republic of Moldova, it is necessary to:

- 1) Approve the application of European regulatory documents in the field of sustainable development (Directive (EU) 2022/2464, CSRD (Corporate Sustainability Reporting Directive), Regulation (EU) 2020/852 known as the EU Taxonomy,
- 2) Modify Law No. 287 of December 15, 2017, “On Accounting and Financial Reporting” and, in particular, supplement it with provisions disclosing information on sustainable development by enterprises, specifying what kind of report public interest entities and large enterprises should submit: a separate report or an appendix to the annual financial statements. In the author's opinion, this should be a separate report on sustainable development,
- 3) Provide corporations with tax incentives for effective management that leads to a reduction in greenhouse gas emissions and environmental pollution. Also, expand the preferences that employers and the state provide to employees in the form of tax incentives.

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SUSTAINABLE SOCIAL DEVELOPMENT PARADIGMS AND FORECASTS

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Abstract: Sustainable social development refers to the process of improving human well-being, equity, and social inclusion while ensuring long-term environmental and economic sustainability. The article explores major paradigms shaping sustainable social development and provides forecasts on future trends in a rapidly changing global context. Sustainable social development has emerged as a central paradigm in addressing global inequalities, environmental degradation, and economic instability. This article explores key theoretical frameworks underpinning sustainable social development, examines contemporary models, and provides forecasts on future trends. By integrating social equity, environmental stewardship, and economic resilience, sustainable development paradigms aim to create inclusive and adaptive societies.

Keywords: sustainable, social, development, forecasts.

Classification JEL: Q01, O15, C53, Q54.

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1. Introduction

Sustainable development gained global prominence with the United Nations and its framework for the Sustainable Development Goals (SDGs). While early development models focused primarily on economic growth, modern approaches emphasize the integration of social equity, environmental protection, and economic resilience. The concept of sustainable social development gained prominence with the publication of the Brundtland Report, which defined sustainable development as meeting present needs without compromising future generations.

Today, it is embedded in global initiatives such as the United Nations' Sustainable Development Goals. Social development focuses on improving human well-being, reducing inequality, and fostering social cohesion. Sustainability adds a long-term, intergenerational dimension, making the paradigm more complex and multidisciplinary.

2. Literature Review

The concept of sustainable development was formally introduced in the Brundtland Report, which established the principle of intergenerational equity. Early literature emphasized balancing economic growth with environmental protection, but later studies expanded the framework to include social dimensions such as equity, participation, and human well-being. Scholars and institutions such as the United Nations Development Programme have played a critical role in operationalizing sustainable development through frameworks like the Human Development Index (HDI), shifting the focus from purely economic indicators to broader measures of societal progress.

The human development paradigm, largely shaped by Amartya Sen, represents a significant shift in development theory. In his seminal work *Development as Freedom*, Sen argues that development should be understood as the expansion of human capabilities rather than merely

income growth. Education and health as core development pillars. Freedom of choice and agency reduction of structural inequalities. This paradigm has been widely adopted in global development discourse and policy design. A substantial body of literature focuses on social exclusion and inequality as barriers to sustainable development. Researchers highlight how marginalized groups based on gender, ethnicity, or socioeconomic status face systemic disadvantages. The Sustainable Development Goals explicitly address these concerns, particularly Goal 10 (Reduced Inequalities) and Goal 5 (Gender Equality). Empirical studies show that inclusive policies significantly enhance long-term social stability and economic resilience.

The integration of environmental sustainability into social development has been explored through the ecological modernization theory. Scholars argue that technological innovation and policy reform can decouple economic growth from environmental degradation.

Research in Environmental Science supports the idea that sustainable resource management and climate adaptation strategies are essential for maintaining social systems. The intersection between environmental stress and social vulnerability is now a central theme in contemporary literature. Participatory development approaches emphasize the role of local communities in shaping development outcomes. Studies indicate that community-driven initiatives tend to be more sustainable and context-specific. have shaped your understanding of the problem. Make sure to identify any gaps, inconsistencies, or underexplored areas in the literature that your paper aims to address. Clearly explain how your research builds upon or challenges existing work and articulate the contribution it intends to make within the academic debate. The review should demonstrate a solid grounding in current scholarly knowledge and debates related to the topic.

3. Methodology

This study adopts a quantitative, interdisciplinary research design integrating sustainability indicators, socio-economic variables, and forecasting techniques. The methodological framework is grounded in the analytical approaches promoted by the Organisation for Economic Co-operation and Development, particularly within the Programme for International Student Assessment context, where sustainability and global competence are increasingly operationalized through measurable indicators.

4. Results and Discussion

The empirical analysis reveals a statistically significant relationship between sustainability indicators, social development variables, and long-term economic performance. The panel regression results indicate that:

- Environmental indicators (e.g., reduced CO₂ emissions and improved energy efficiency) are positively associated with sustainable development outcomes ($\beta_1 > 0$, $p < 0.05$).
- Social variables, particularly education outcomes and human development levels, show a strong and robust effect on sustainability ($\beta_2 > 0$, $p < 0.01$).
- Economic variables, such as GDP growth, display a conditional impact, suggesting that growth contributes positively to sustainability only when accompanied by inclusive social policies.

The empirical findings indicate a close relationship between sustainability performance, social development indicators, and long-term economic resilience. In particular, education-related variables and human development indicators appear to be positively associated with sustainability outcomes. This result is consistent with the analytical frameworks developed by the Organisation for Economic Co-operation and Development, especially those related to education quality and global competence assessed through the Programme for International Student Assessment.

The forecasting analysis, based on ARIMA and VAR models, suggests three possible development trajectories. Under the baseline scenario, sustainability indicators are expected to improve moderately, although regional disparities in social development are likely to persist. This scenario reflects a continuation of current policy trends, with gradual progress in environmental and social indicators but without substantial convergence between regions.

Under the optimistic scenario, which assumes stronger policy intervention, the results indicate more substantial progress in both environmental and social indicators. In this case, investments in education, human capital formation, social inclusion, and institutional capacity may generate positive spillover effects on sustainable development and economic resilience. This trajectory suggests that coordinated policy action can accelerate improvements in sustainability outcomes.

By contrast, the pessimistic scenario, based on limited policy intervention and weak institutional coordination, points to stagnation or decline in sustainability performance. This trajectory is associated with widening social inequalities, slower improvements in human development indicators, and increased environmental pressure. The results therefore suggest that policy inaction may reinforce existing vulnerabilities and reduce long-term adaptive capacity.

The accuracy of the forecasting models should be interpreted with caution. Forecast accuracy indicators, such as RMSE and MAE, need to be reported explicitly in order to assess the reliability of the projections. These indicators are particularly important for distinguishing between short-, medium-, and long-term forecasting performance. In general, the projections may be considered more reliable over short and medium horizons, while uncertainty increases over longer periods due to external shocks, structural changes, and data limitations.

The results highlight three main insights. First, sustainability should not be interpreted only as an environmental objective, but as a multidimensional process connected to education, equity, well-being, institutional capacity, and economic resilience. Second, education and global competencies play an important role in shaping sustainable behaviours and strengthening long-term adaptive capacity. This finding is supported by international frameworks that link education quality, skills formation, and social resilience. Third, integrated policy approaches are necessary, because economic growth alone is insufficient to ensure sustainable development. Effective policy design should therefore combine environmental protection, social inclusion, investment in education, and economic resilience within a coherent governance framework.

Overall, the findings suggest that sustainable social development depends on the interaction between environmental, social, and economic factors. The results also underline the importance of proactive policy intervention, particularly in education and human capital development, as a condition for improving sustainability performance and reducing long-term social vulnerabilities.

Comparison with Existing Literature

The results are consistent with prior research indicating that sustainable development requires a balanced interaction between economic, social, and environmental pillars. Existing studies further highlight that education and human capital function as key enablers of sustainability transitions, while forecasting models are widely recognized as valuable instruments for policy analysis and planning. However, the literature also underscores that such models must account for uncertainty, structural breaks, and evolving socio-economic conditions.

Limitations and Further Research

Although the results are robust, several limitations should be acknowledged. First, potential endogeneity between key variables may influence estimation accuracy. Second, differences in data quality and measurement across countries may affect comparability. Third, forecasting outcomes are sensitive to external shocks such as economic crises, geopolitical instability, or climate-related events.

Future research should extend the analysis by incorporating micro-level datasets at the household or firm level to capture more granular dynamics. In addition, further studies should examine behavioral dimensions of sustainability to better understand individual and organizational decision-making processes. Finally, the integration of machine learning techniques may improve forecasting accuracy and enhance the model's ability to capture complex nonlinear relationships.

The Figure 1 illustrates the interdependence between environmental, social, and economic dimensions of sustainable development, alongside projected sustainability trajectories and forecasts of GDP growth and income inequality. The left panel presents a conceptual Venn diagram integrating environmental indicators (CO₂ emissions, energy use), social indicators (human development, education, inequality), and economic indicators (GDP growth, employment). The right panels display (i) projected sustainability index trends under optimistic, baseline, and pessimistic scenarios (2000–2035), and (ii) forecasted GDP growth and Gini coefficient trends (2010–2030).

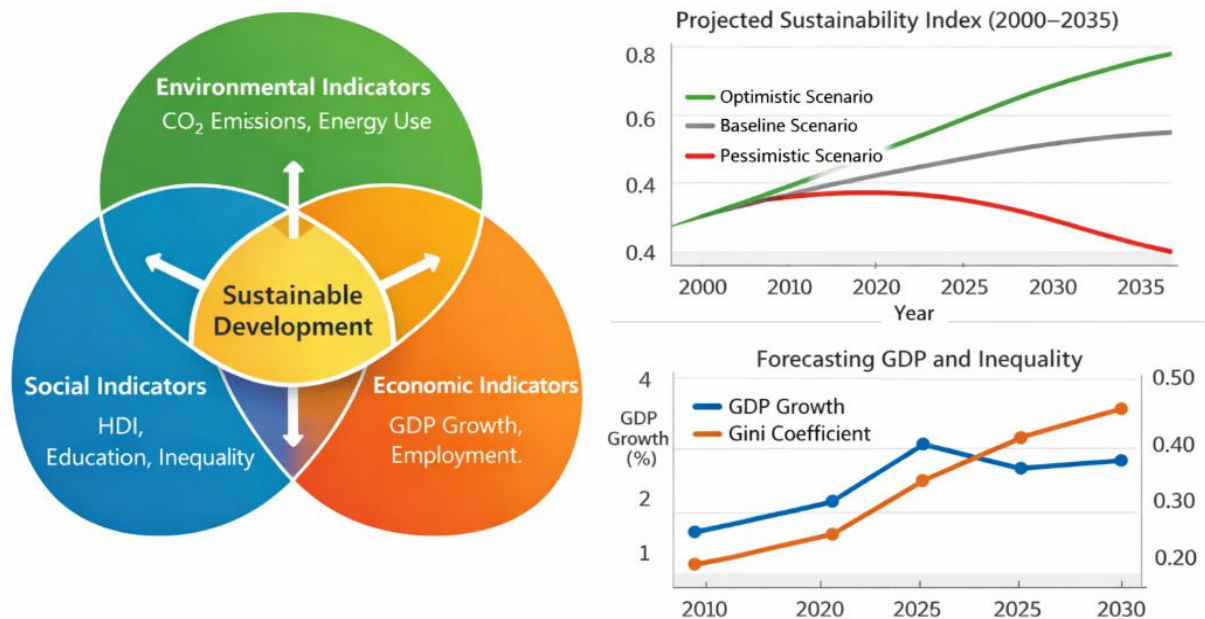


Figure 1. Sustainable Development, Social Indicators, and Forecasting Scenarios

Source. Author's own elaboration based on data and frameworks from the Organisation for Economic Co-operation and Development, World Bank, and United Nations Development Programme.

Sustainable development has evolved into a multidimensional framework integrating environmental protection, social inclusion, and economic resilience. Recent literature highlights that environmental policies alone are insufficient without corresponding investments in human capital and institutional capacity.

Organizations such as the Organisation for Economic Co-operation and Development and the United Nations Development Programme emphasize the role of education, governance, and inequality reduction in achieving long-term sustainability. In parallel, global assessment frameworks like the Programme for International Student Assessment (PISA) demonstrate the importance of cognitive skills and global competence in shaping societal outcomes. The findings confirm that sustainability is inherently multidimensional, integrating environmental, social, and economic systems. This supports the integrated development frameworks promoted by the United Nations Educational, Scientific and Cultural Organization.

5. Conclusions

Sustainable social development is no longer optional it is essential for global stability and human progress. Integrating inclusive policies, technological innovation, and environmental stewardship will define successful development strategies in the coming decades. Collaboration between governments, civil society, and international organizations like the United Nations Development Programme will be critical to achieving these goals. This study demonstrates that sustainability outcomes are strongly influenced by social development particularly education and that economic growth contributes positively only under inclusive institutional conditions. Forecasting results further highlight the importance of proactive policy intervention. Overall, human capital emerges as a foundational driver of sustainable development.

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ACHIEVING SOCIAL SUSTAINABLE DEVELOPMENT GOALS THROUGH ESG - A CONCEPTUAL ANALYSIS

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Abstract: The concept of ESG is dynamic and versatile and particularly targets the conduct of companies that, in addition to financial and performance criteria, propose to integrate social, environmental and good governance elements. Through this compliance with ESG, companies aim to be able to maintain their dominant position in the market, to obtain investments or bank loans much more easily or under better conditions, but also to contribute positively and actively to the world in which they operate. From this perspective, ESG becomes an assessment tool and attitudinal guidance at the company management level regarding sustainability and responsible behavior. At the macroeconomic level, the extensive and generalized application of ESG at the company level can create structural changes in society regarding organizational performance, contributing to the achievement of the 2030 Agenda. From this perspective, the study aims to analyze the conceptual framework regarding the interdependencies between ESG and sustainable development targets regarding the social component. The methodology aims at a theoretical, explanatory, conceptual and functional analysis of the connections between the two elements. From this perspective, the study will focus on the conceptual analysis of SDGs 3,4,5,8 and 10 in relation to ESG. The results confirm the capacity of ESG to assess and implement sustainable development targets at the company level, but also the capacity of SDGs to expand and build the broad normative framework for ESG functioning.

Keywords: ESG framework, SDGs, social sustainability.

Classification JEL: G41, M14, Q01.

UDC: 005.35:502.131.1 **DOI:** <https://doi.org/10.53486/ser2026.17>

1. Introduction

The ESG (Environmental, Social, and Governance) framework represents a dominant factor promoting sustainable organizational policies and strategies, constantly aiming not only to achieve the vital economic and financial elements of the company, but also elements that can strengthen its resistance over time and create opportunities for medium and long-term development in full harmony with society's desires for a better, more qualitative life, more connected to the environment and community.

The ESG standard on the social component targets the company's relationship with suppliers, customers, employees and communities and refers to working and living conditions, especially health, safety, education and training, diversity, social inclusion, compliance with corporate social responsibility by relating to people. Not only economic objectives are valuable, companies through ESG aim to achieve objectives such as: gender equality between women and men, increasing employee health, increasing employee digital education, employing people with disabilities or

supporting families of employees with such problems, but also other initiatives and projects that achieve the motivation and involvement of human resources at the company level.

The article aims to analyze the conceptual, theoretical, logical and functional relationship between the Social Objectives of the Sustainable Development Goals (SDGs) (especially SDG3 - Good health and well-being, SDG 4 - Quality education, SDG 5 - Gender equality, SDG 8 - Decent work and economic growth and SDG 10 - Reduced inequalities) and ESG. By pursuing the SDGs at the company level, but also by society as a whole, their aggregate effort can be reflected in profound structural changes in society, but also in the performance and conduct of the organization in the environment in which it operates, potentially boosting the achievement of the 2030 Agenda objectives.

The integration of sustainable development goals at the company level can be considered as a function of the social, environmental and governance parameters of ESG. If we refer strictly to the social framework, we can consider that the social sustainable development goals (SSDGs) can be met at the company level to the extent that the ESG policy of this type (SESG or the S form ESG) is identified, recognized, understood and integrated. Of course, the social ESG externalities are beyond the social framework, also affecting good governance and environmental policies, but for simplicity, it can be considered necessary to first understand the link between ESG social and social SDGs.

2. Literature Review

The literature accurately captures the multifaceted nature of ESG with implications for company success, increasing firm value, promoting quality management and good practices, reducing risk, and promoting investment (Eccles, Ioannou, & Serafeim, 2014; Friede, Busch & Bassen, 2015; Palma-Ruiz, Castillo-Apraiz, Gómez-Martínez, 2020; Liang, Lee, & Jung, 2022; Narula, Rao & Rao, 2023; Shehawy, Khan and Madkhali, 2024; Zairis, Liargovas, & Apostolopoulos, 2024). The social ESG captured by the literature emphasizes that it has the ability to reduce social inequality, ensure inclusion and safety at work, support employees, suppliers, customers, investors, but the company's effort must be real and verifiable, otherwise it is perceived as a narrative devoid of content and penalized in assessments (Barrientos, Gereffi and Rossi, 2011; Piasecki and Gudowski, 2017; Amel-Zadeh and Serafeim, 2018; Cao et al., 2023; Chen et al., 2025).

Regarding regulatory frameworks, although there are many frameworks (e.g. Global Reporting Initiative - GRI; International Integrated Reporting Council – IIRC; Task Force on Climate-Related Financial Disclosure -TCFD), the literature points out that the European regulatory framework (European Sustainability Reporting Standards ESRS), is more integrated, transparent, predictable, normalized, comprehensive, mature and comprehensive, providing the guidelines for companies in the EU and beyond this specific area (European Commission, 2023; Leal Filho et al, 2025; Costea et al., 2025). That's why many studies use the definitions, terminologies and regulations at the EU level as good references for specific ESG requirements.

The link between ESG and SDGs is analyzed by a multitude of studies, most of which reflect the capacity of corporate leadership and strategy to implement the basic principles of sustainability at the company level. These aspects are also reflected in rigorous analyses that track social impact. For example, Alhazemi (2025) analyzes the impact of ESG factors and ethical leadership on community well-being, employees, education and training, through a structural equation modeling – partial least squares (SEM-PLS) based on a sample of 871 respondents. The results of this study indicated that good governance and responsible and ethical leadership improve community and employee well-being and engagement, inclusion and diversity, especially in supporting SDGs 3, 4, 5, 8, 10, 11 and 16. These results are also confirmed in other studies capturing the effects of ESG on other SDGs (Wilburn & Wilburn, 2020; Bezerra et al., 2024; Chen et al., 2025; Costea et al., 2025). However,

there is still a growing need to deepen and understand the connection between ESG and SDGs, starting from theoretical frameworks to deepening empirical and applied analyses.

3. Methodology

The study methodology consists of a comparative, interrogative analysis of the specialized literature, in outlining and finding theoretical, explanatory, conceptual and operational arguments in the majority of the analyzed studies from the main data sources WOS and MDPI, etc. The study mainly tries to clarify the theoretical framework and find the best coupling between ESG with a focus on social ESG and SDGs with a focus on social objectives. Although the literature abounds in the use of numerous SDGs, including those of governance or those that describe rather primary needs, the present analysis focuses only on SDGs 3,4,5,8 and 10. This should not be seen as limiting; subsequent studies may narrow or broaden the area of study of SDGs depending on the concrete needs of future studies.

4. Results and Discussion

The *conceptual framework* attempts to explain the importance of social ESG (ESGS) as an element of expanding the framework for evaluating a company's performance beyond profitability, performance, market share, etc., by pursuing employee rights, social inclusion, well-being, health, diversity, community relations. These elements are pursued at the SDG level, in particular through the targets SDG 3 (Good Health and Well-Being), SDG 4 (Quality education), SDG 5 (Gender Equality), SDG 8 (Decent work and economic growth) and SDG 10 (Reduced Inequalities).

SDG3 aims to ensure health (reproductive, infant, mental, disease transmission and epidemic containment, mortality reduction, reduction of risk factors, but also of non-communicable diseases) and well-being of people in the medium and long term through assistance with medical care.

SDG4 aims at access to education throughout life, trying to prepare, from early childhood to adulthood, to obtain important skills that allow employment or obtaining decent jobs. Although it does not strictly achieve social objectives, education is the quintessence of a better life, a fulfilled social life, the basis for a better job, for a decent or high income and the excess of concern for tomorrow, as well as the basis for careful involvement in the objectives of the family, the community, but also of the workplace where the individual works.

SDG5 is concerned with gender equality, eliminating violence, discrimination, eliminating practices against women and young women and encouraging public and private leadership and female entrepreneurship. From gender-based violence to pay, education and leadership, women face stressful and disadvantaged situations throughout their lives, a fact carefully reflected in specific monitoring indicators such as: Early leavers from education and training by sex; Gender pay gap in unadjusted form; Seats held by women in national parliaments and governments; Physical and sexual violence to women by age group; Population in private households by educational attainment level; Gender employment gap, by type of employment; Persons outside the labour force due to caring responsibilities by sex; Positions held by women in senior management (Source: Eurostat).

SDG8 looks at the general framework of social development such as sustainable economic growth and productivity, job creation, decent working conditions, quality and well-paid jobs and the creation of opportunities for workforce development.

SDG10 addresses the issue of inequalities between and within countries, regardless of the type of inequality: disability, ethnicity, religion, age, social status, gender, race, income, implicitly addressing the issue of migration as a cause of inequality and poor social inclusion as a result of migration or other causes.

ESG is a management vehicle for implementing sustainable development goals, constantly measuring alignment with these goals, representing an input or input factor in the corporate implementation of the SDGs, closely monitoring the impact of responsible investments with the desired and expected social impact. Thus, the SSDGs objectives are translated into social ESG (SESG) as an integral part of the company's policies, which must, in addition to the interests of shareholders, also protect the interests of employees, suppliers, customers and the local community. Also, through an appropriate transparency and social involvement policy, companies can see social, governance and environmental impact as a concrete material aspect of financial reporting, actively including them in internal policies through corporate responsibility. Thus, ESG reporting can improve not only transparency and public image, but also the responsibilities of companies in relation to all social stakeholders, contributing to overall social development. Thus, to achieve the SSDGs (especially targets 3,4,5,8 and 10), SESG influences social factors at the company level by adopting policies of equity, diversity, education, occupational health, and inclusion.

Thus, from a *theoretical and functional* perspective, it can be considered that ESG is a corporate mechanism with an operational function that aims, through the social dimension, to achieve the global normative framework of the SDGs. So metaphorically speaking, social ESG is the vehicle that moves on a well-oriented predetermined path, the social dimension, and the environment are the social sustainable development goals (SSDGs) (see Figure 1).



Figure 1. General framework for analyzing the link between SESG and SSDGs

Source: Authors' conception, Chat GPT assistance in creating the image

Figure 2 shows the successive stages or the logical model of materializing the implementation of social ESG up to the level of achieving the social Sustainable Development Goals (SDG). Thus, ESG can be considered an input factor, which can reconfigure the company's internal panoply of tools, then it goes through a transmission process, transfiguring itself into the company's social policies, then follows the result, in which part of the ESG targets can be tracked whether they are achieved or not, and then the degree of alignment with the SDGs is analyzed. If it can be considered that the degree of alignment is precarious, a new entry into the circuit with additional requirements is restarted from the targets, so a new design of ESG in social matters is projected until the desired result is obtained.

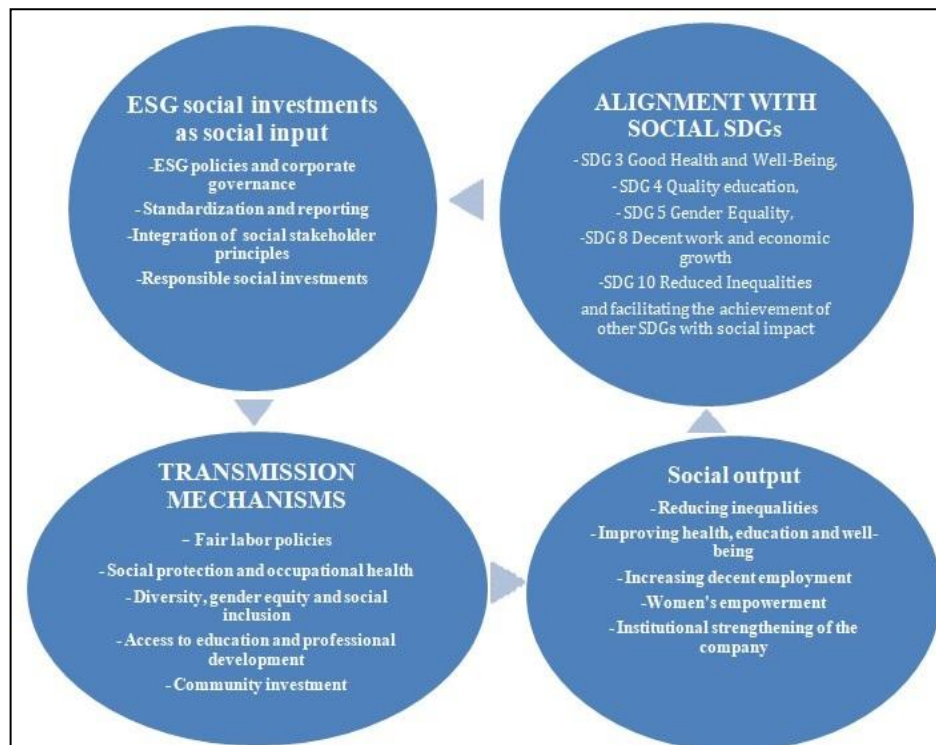


Figure 2. The logical model for integrating social ESG into the SDGs

Source: Authors' conception

The same process can be reproduced with regard to the degrees of integration or the levels of deepening of the problem at the level of the company. Thus, table 1 starts from the conceptual, assertive level, it follows an operational integration, in which a series of ESG indicators are designed to be achieved through an internal strategy well aligned with ESG. In the last phase, the degree of transformational integration is analyzed, in which the company not only has ESG strategies properly aligned with the SDGs, but are also well put into practice, and the results are fully visible in society, in the company's external environment.

Table 1. Degrees of integration of SESG into SSDGs

Degree of integration	Description	Application
Assertive integration	SSDGs identified in SESG reports	Sustainable development reports and other internal reports which show concerns for sustainable path.
Operational-functional integration	Key indicators of SESG in line with SSDGs targets	Gender alignment indicators, inequality reduction indicators, educational indicators monitored at company level etc.
Timely and strategic integration	SSDGs integrated into SESG and the company's business model	Human resources policies and strategies focused on good social practices and inclusion, diversity, health and education at work, etc.
Transformational integration	A business model already well adapted to society, implemented to bring maximum impact	Investments with considerable social impact.

Source: Authors' conception

Figure 3 presents the conceptual mapping between ESG indicators and the social Sustainable Development Goals (SDGs). The matrix highlights the alignment of ESG indicators related to health, education, employment and inequality with the SDGs and the visualization illustrates the extent to which ESG indicators contribute to achieving specific SDGs in a simultaneous manner.

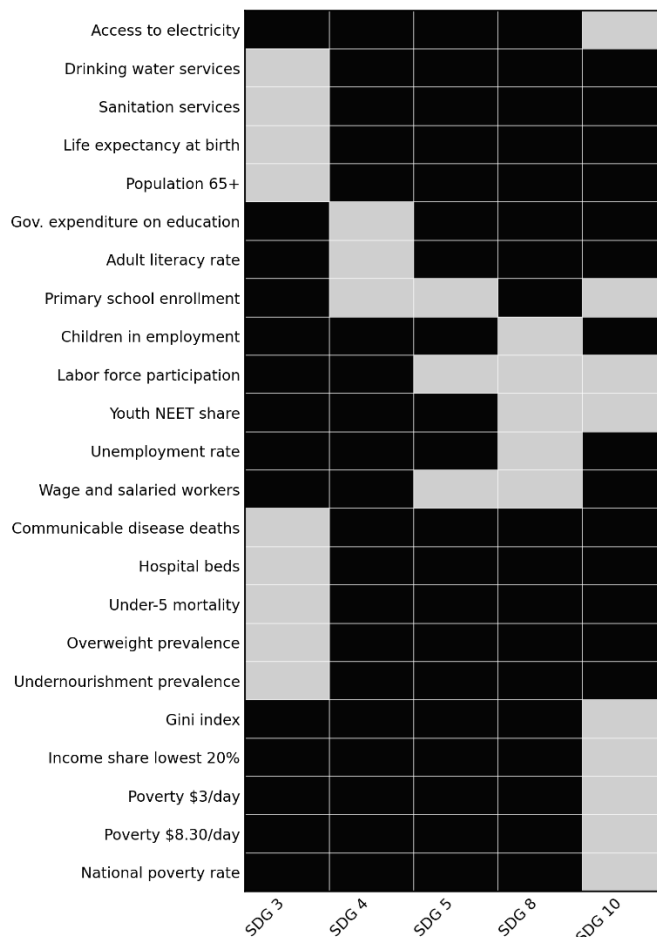


Figure 3. The logical model for integrating S ESG into the SSDGs

Source: Authors' conception, base on World Bank database and Sustainable development in the European Union Monitoring report on progress towards the SDGs in an EU context 2025 edition (Eurostat, 2025), Chat GPT assistance in creating the image.

Note: Dark cells indicate the existence of a link between ESG and SDGs, and a lighter color indicates the absence of a direct correlation.

Thus, it can be seen that in most cases, the various types of social ESG analysis directions have a good reflection and the targets of sustainable development with the same character, and that in general the various ESG aspects are covered almost at par with the targets of sustainable development (the dark color in the graph reflects this). However, there are gaps in coverage, ESG indicators and policies with a social character are not unitary, and they do not have a universal character, which is why the degree of local, national, regional and international comparability is still relatively low.

5. Conclusions

The article attempts to clarify from a theoretical, conceptual and functional perspective the role of social ESG (SESG) in the implementation of SSDGs by providing companies with an evaluative

structure and operational implementation mechanisms, and in return the SSDGs framework offers a wide range of options that allow companies to have policies and strategies in which the company's practices and conduct lead to a long-term sustainable global development framework.

The results of the theoretical analyses indeed indicate the capacity of ESG to transpose the SDGs at the company level, but elements such as the lack of unitary standardization in ESG reporting and a lack of clear and unified methodology for measuring social impact must be taken into account, affecting the compatibility and ability to concretely track the contribution to achieving the SDGs.

The study may be of particular interest to managers, leaders, public decision-makers and activists in the field of sustainability. In order to increase the importance of ESG in achieving the targets of sustainable development, not only internal policies must be aligned with ESG and SDGs, but especially the way of choosing and training management personnel, teams and all employees, so that it is a priority for all of them to create and support an ethical, inclusive, non-discriminatory, motivational and sustainable work environment.

The social ESG framework represents not only a conceptual analysis of dangers and risks for employees, customers, suppliers, society, managers and the community, but also possibilities and opportunities, which depending on the context, industry, organization, geographical position, climate, etc., can prove extremely valuable in the development of the company in the future. Therefore, it is important to use SESG framework as an active tool for managing the dangers that may lurk in the company, using the challenges as a lever for internal development to actively prevent possible unfavourable evolutions in the future.

For better integration of sustainable development targets with social character (SSDGs), a company must adjust its intensity of ESG implementation, reporting policies, manage social pressure from all stakeholders, but also adjust accordingly to the social, political, economic, institutional context, etc. at the local, national, regional and international levels.

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HOW TO INCREASE TAKE-UP RATE OF SOCIAL BENEFITS IN HUNGARY – TOWARDS SUSTAINABLE SOCIAL DEVELOPMENT

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Abstract: *Low take-up of social supports represents a persistent challenge for welfare systems, undermining both their effectiveness and social legitimacy. This study examines the determinants of supports non-take-up in Hungary, with a particular focus on Győr-Moson-Sopron County, one of the country's most economically advanced regions. Despite favorable labor market conditions, a proportion of the population remains vulnerable and dependent on social assistance, highlighting the importance of well-functioning support systems. The research is based on a survey conducted in 2024 among local municipalities, capturing expert insights from mayors, notaries, and social administrators. The findings indicate that the system of social supports is perceived as moderately effective and relatively transparent; however, notable deficiencies persist in terms of equitability and targeting accuracy. A key structural barrier is the presence of undeclared employment, which distorts eligibility assessments. The study identifies stigma associated with benefit claiming as the primary factor behind low take-up, alongside insufficient information and the perceived inadequacy of benefits. Policy recommendations emphasize the need for reducing stigma through targeted communication, improving access to information, strengthening administrative transparency, and addressing informal employment. Enhancing take-up rates is essential not only for improving system efficiency but also for promoting inclusive and sustainable social development.*

Keywords: *take-up rate, system of social supports, sustainable development, Győr-Moson-Sopron County, efficiency, transparency, equitability.*

Classification JEL: *I38.*

UDC: *364.4:316.42(439)* **DOI:** <https://doi.org/10.53486/ser2026.18>

1. Introduction

Although there has long been debate over how extensive the state's role should be in providing support to low-income populations, the necessity of such assistance is widely acknowledged. Public intervention typically seeks to reduce poverty through means-tested benefits. Even though many of these programs are designed to improve the living conditions of disadvantaged groups, a significant challenge lies in their low uptake: social supports and services often fail to reach all those they are intended for.

This lack of uptake represents a serious issue for both the effectiveness and the legitimacy of welfare systems globally. It limits individuals' ability to cope with socio-economic changes and to develop the capacity to adapt to them. When a substantial proportion of eligible individuals do not claim benefits, it weakens the system's ability to reduce poverty and creates unjust disparities among those who qualify. Furthermore, high levels of non-take-up can lead to delays in accessing healthcare, lower educational outcomes, and unsafe or unstable environments for children.

Beyond its immediate policy implications, the functioning of the social assistance system is closely linked to the broader framework of sustainable social development. In this context, sustainability extends beyond environmental concerns and encompasses the long-term stability, inclusiveness, and resilience of social systems. Sustainable development is widely

understood as a process that integrates social, economic, and environmental objectives while ensuring that present needs are met without compromising future generations' opportunities (Hediger, 2000).

While a considerable body of research has examined benefit non-take-up in Western European countries, this issue has received less attention in Central and Eastern Europe (CEE). In many of these countries, including Hungary, the discussion has largely focused on “accurate targeting,” emphasizing the exclusion of ineligible recipients from welfare programs. In contrast, comparatively little attention has been given to the problem of eligible individuals who do not receive benefits. The aim of the research is to examine the effectiveness, transparency, and equitability of the system of social supports in Győr–Moson–Sopron County, Hungary, and to formulate recommendations about how to increase the take-up rate of social benefits. To do so, representatives of approximately one fourth of the local municipalities were asked to gather their local expert knowledge and to draw conclusions.

2. Literature Review

Hungary has long been characterized by significant and spatially uneven economic and social inequalities (Kocziszký, Lipták&Szendi, 2023; Péter&Orosz, 2023, Orosz&Kiss, 2025). These disparities became particularly pronounced following the political and economic transition of the early 1990s, when regional differences widened rapidly. Budapest further strengthened its dominant role, while the gap between more developed “core” regions and less developed “peripheral” areas deepened considerably.

Although the growth of regional divergence slowed from the mid-1990s onward (Nemes Nagy 2005; Kiss 2008), structural inequalities have persisted. Certain areas—most notably Budapest and the western border regions - have maintained a sustained development trajectory due to favorable geographic positioning, stronger economic integration, and better access to international markets (Tóth&Nagy, 2016). In the post-2000 period, Hungary's spatial structure has continued to reflect a dual pattern: a developed core, including Budapest and the northwestern Transdanubian region and a less developed periphery, particularly in northeastern and southern parts of the country (Pénzes&Kiss, 2025).

Győr–Moson–Sopron County is one of Hungary's most developed regions and forms part of the dynamic, export-oriented Western Transdanubian economic zone. Its competitive advantage stems from several interconnected factors:

- A strong industrial base, especially in the automotive sector;
- Proximity to Austria and Slovakia, enabling cross-border economic integration;
- Favorable demographic trends, including population growth since the 2010s.

The region benefits significantly from its border location, facilitating trade, labor mobility, and participation in cross-border development programs. At the same time, its strong export orientation makes it sensitive to fluctuations in global industrial cycles.

The labor market in Győr–Moson–Sopron County is notably strong compared to the national average. Its employment rates have steadily increased in recent years, reaching 69.7% in 2024 (KSH), which is among the highest in Hungary. Besides, unemployment remains exceptionally low (around 2.1% according to KSH data). The workforce is relatively well-educated, particularly in technical and vocational fields. At the same time,

demand for higher education qualifications and service-sector skills is growing, reflecting structural shifts in the economy.

Even if Győr–Moson–Sopron County is a developed area in all aspects, a part of its population lives under the poverty line and requires external help. Therefore, the functioning of the system of social supports is crucial. In an ideally designed and properly functioning system, both vertical and horizontal efficiency are realized simultaneously. This means that all individuals who are entitled to benefits receive them, while those who are not in need are effectively excluded from support. In such a scenario, the set of eligible individuals perfectly overlaps with the set of recipients, ensuring that no one is left outside their intersection.

In practice, however, various forms of system malfunction can be observed, particularly when social support fails to produce meaningful improvements in beneficiaries' living conditions. The concept of deadweight loss is typically used to describe situations where resources are allocated inefficiently. This occurs, for example, when some eligible individuals do not receive the benefits to which they are entitled. Such cases are often associated with low take-up or limited access, indicating shortcomings in horizontal efficiency. Conversely, there are also instances where individuals receive benefits despite not meeting eligibility criteria. These cases reflect deficiencies in vertical efficiency (Siposne&Nandori, 2025).

The effectiveness of social assistance largely depends on how transparent the system is, how well eligible individuals are informed about available benefits, how familiar they are with the application conditions, and how accurately they can assess whether they are entitled to a given form of support. In addition, the equitability and efficiency of the system is also an important benchmark (Balogh&R. Fedor, 2014). The system is considered efficient if only those in need receive benefits and none of those in need are left without support (Barr, 2009; Ferge, 2008).

An effective and well-targeted social assistance system contributes to sustainability in several ways. First, it helps reduce structural inequalities and mitigates the risks of social exclusion, which are central concerns of both social protection and sustainable development frameworks. Social protection policies are explicitly designed to reduce vulnerability and support disadvantaged groups, thereby contributing to more inclusive development trajectories (Cluver et al., 2016). Even in relatively prosperous regions, such as Győr–Moson–Sopron County, hidden forms of vulnerability - linked to precarious or informal employment - justify the continued relevance of targeted support mechanisms. Second, transparency and fairness in benefit allocation enhance institutional trust and governance quality, which are key components of sustainable social systems.

Social protection policies are not only redistributive tools but also instruments for strengthening social cohesion and political legitimacy, both of which are essential for long-term development and stability (Norton et al., 2003). Finally, improving efficiency and targeting of social benefits supports the optimal allocation of public resources, which is crucial for fiscal and social sustainability. Inaccurate targeting can weaken the overall effectiveness of social policies and reduce their contribution to poverty reduction and long-term welfare improvements (Patel&Midgley, 2023).

3. Methodology

During the data collection phase in 2024, local governments in Győr–Moson–Sopron County were surveyed. The data were gathered using an online questionnaire that included both open-ended and closed-ended questions, allowing for a combination of quantitative and qualitative insights.

All mayors of the municipalities in the county were contacted electronically, and in cases of non-response, follow-up phone calls were made to increase participation. As a result, completed questionnaires were received from 43 out of the county's 183 municipalities, corresponding to a sample coverage of approximately 23%. Most respondents (93%) were mayors, notaries, or social administrators. This ensured that the analysis could rely on professionally grounded, institution-level perspectives on the functioning of the social assistance system, rather than public perceptions.

Regarding professional experience in the municipal sector, a substantial share of respondents reported long tenures, typically exceeding ten years. This suggests that participants not only possess a solid understanding of the current regulatory framework but are also capable of assessing the evolution, reforms, and local impacts of the social assistance system over time. The insights provided by this experienced group of practitioners are therefore particularly valuable when evaluating key dimensions such as efficiency and fairness. The data collected were then analyzed with SPSS program.

4. Results and Discussion

Most respondents consider the social assistance system to be moderately effective (Figure 1). Despite the favorable labor market conditions in the central region, there is a view that the system does not always achieve its intended goals: some people in need may be excluded from benefits, while hidden incomes and undeclared employment can distort the assessment of eligibility.

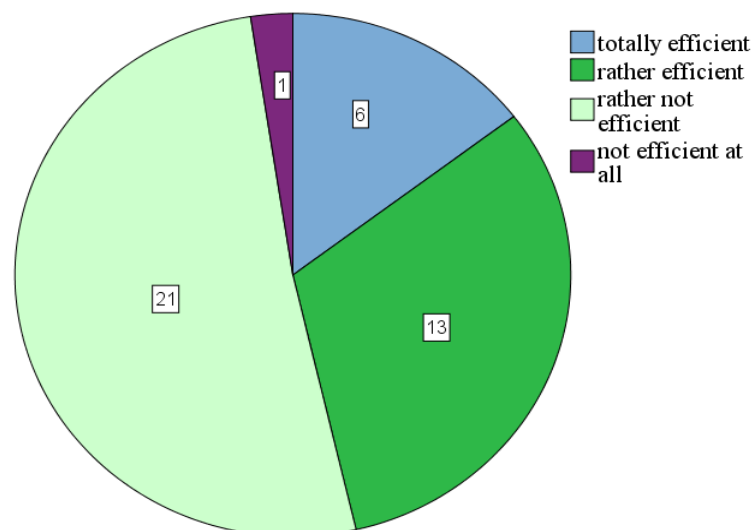


Figure 1. How effective is the system of social supports?

Source: own compilation

A key structural factor underlying these inefficiencies is the presence of hidden incomes and undeclared employment, which can significantly distort eligibility assessments. When income is not fully observable, it becomes difficult for authorities to accurately identify target groups, thereby weakening the precision of benefit allocation. This finding is consistent with earlier observations in the study, which identified undeclared work as a major obstacle to improving the targeting accuracy of social assistance.

The current social assistance system's transparency can be assessed as generally moderate or better, according to the majority of respondents (Figure 2). At the same time, a notable minority (24%) believe that the system is only partially transparent. This result suggests that, although the administrative and legal frameworks are basically understandable for local decision-makers and those in need, the complexity of eligibility criteria and the diversity of benefit types may make consistent interpretation and application more difficult.

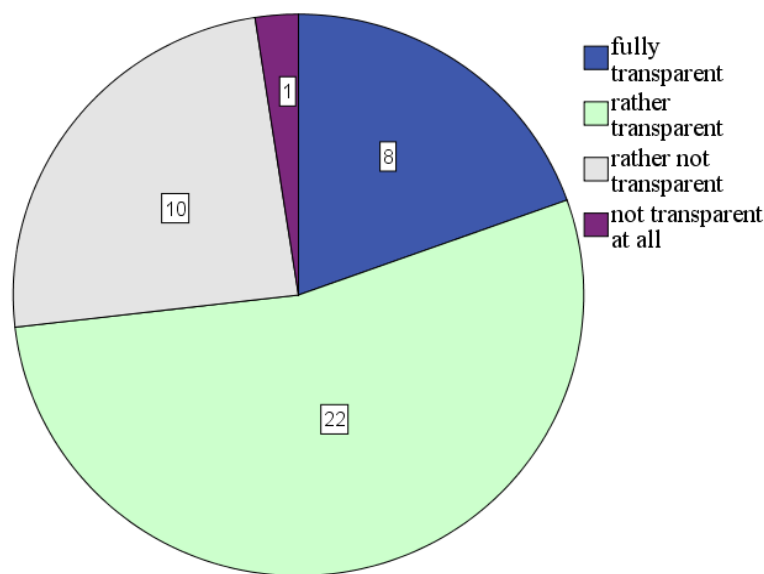


Figure 2. How transparent is the system of social supports?

Source: own compilation

The assessment of equitability (Figure 3) reveals a more divided pattern. Although most respondents tend to view the system as broadly equitable, critical opinions appear more frequently than in the case of transparency. This indicates that, according to local experience, access to benefits is not always evenly distributed among those in need. In some cases, eligibility criteria may lack sufficient flexibility to account for diverse and complex life situations, such as irregular employment, household-level vulnerabilities, or sudden income shocks. As a result, certain groups may be disadvantaged despite formally meeting - or nearly meeting - the conditions for support.

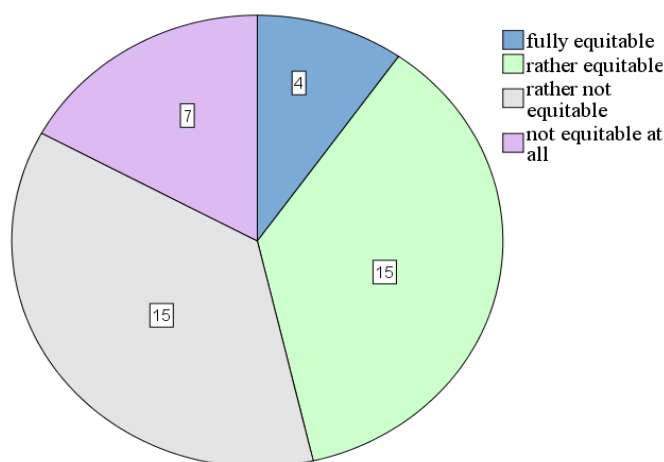


Figure 3: How equitable is the system of social supports?

Source: own compilation

When asking questions about the reasons for the low take-up, most respondents said that the main reason was the stigmatizing nature of receiving support (Figure 4). According to Baumberg (2016), in areas where a significant proportion of the population receives social assistance, applicants are less likely to perceive benefit uptake as stigmatizing due to the emergence of so-called “welfare dependency” Bertrand et al. (2000) and Rege et al. (2012) demonstrate that individuals are more likely to claim benefits when others in their immediate social environment do the same. Their findings suggest that in regions where both poverty levels and the share of benefit recipients are lower, the degree of stigma associated with claiming social assistance tends to be higher.

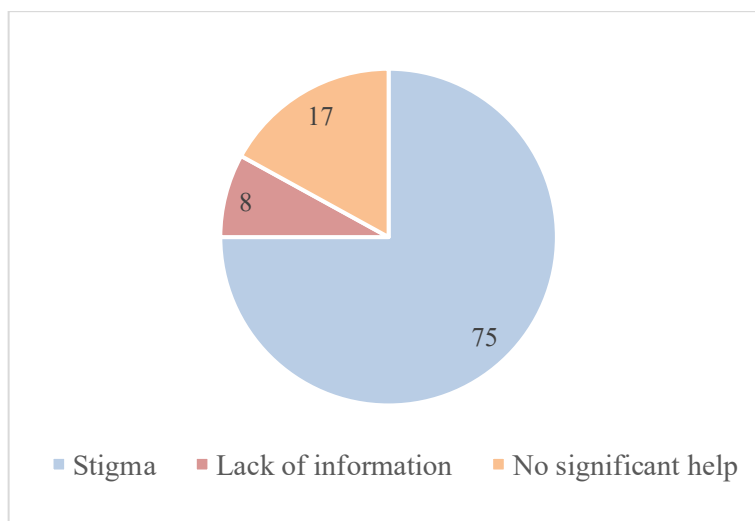


Figure 4. Reasons for low take-up

Source: own compilation

Another important reason for low take-up is that eligible individuals believe that social support does not mean significant help for them. Besides, the lack of information about the available support can also decrease the take-up rate.

5. Conclusions

According to the assessment of municipal professionals, the transparency and equitability of the system of social supports are generally acceptable, but not without shortcomings. Deficiencies are particularly evident in terms of fairness and efficiency. The presence of undeclared employment further weakens the targeting accuracy of the system and makes it more difficult to ensure that only those truly in need receive support.

Overall, the findings suggest that in central regions, social assistance primarily serves a supplementary, safety-net function, while the strong performance of the local economy reduces the overall level of need. However, the persistence of non-take-up indicates that even in economically advanced areas, the system does not fully reach its target population.

In response to the central research question - how to increase the take-up rate of social benefits in Hungary - the results point to several key directions for policy intervention. First, reducing the stigmatizing nature of benefit claiming is essential. Since stigma was identified as the most important barrier, communication strategies should aim to reframe social assistance as a legitimate entitlement rather than a sign of failure. This could include awareness campaigns, community-level engagement, and the normalization of benefit use, particularly in regions where take-up rate is currently low. Furthermore, improving access to information is crucial. Many eligible individuals remain outside the system simply because they are not fully aware of available benefits or do not understand the application process. Targeted information campaigns, simplified communication, and proactive outreach by local authorities could significantly increase participation.

Besides, addressing undeclared employment is also essential for increasing take-up. Informal economic activity not only distorts eligibility assessments but may also discourage individuals from engaging with formal institutions. Policies aimed at labor market formalization would therefore indirectly contribute to higher take-up rates. Finally, increasing the perceived adequacy and relevance of benefits may also play a role. If potential beneficiaries consider the level of support insufficient relative to the administrative effort or perceived stigma, they are less likely to apply. Adjusting benefit levels and aligning them more closely with actual needs could improve both participation and effectiveness.

In summary, increasing the take-up rate of social benefits in Hungary requires a multi-dimensional approach that simultaneously addresses informational, administrative, social, and structural barriers. Such improvements would not only enhance the effectiveness of the system of social support but also contribute to more inclusive and sustainable social development, by ensuring that support reaches all those who need it.

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THE ROLE OF TRANSPORT SECTOR IN SHAPING THE ECONOMIC SECURITY OF COUNTRIES ON THE EXAMPLES OF RUSSIA AND MOLDOVA

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Abstract: *The article is devoted to the economic security of the state in the context of transport infrastructure. The components of the transport infrastructure of the Russian Federation and the Republic of Moldova, the performance indicators of the transport systems use of these countries are considered. An analysis of the problems of economic security of the Republic of Moldova in connection with the insufficient development of its transport communications has been carried out.*

Keywords: *transport infrastructure, transport sector, railway transport, economic security.*

Classification JEL: *F52, L91, L92, L93, O18, O52, R42.*

UDC: *338.47:338.246(470+478)* **DOI:** <https://doi.org/10.53486/ser2026.19>

1. Introduction

The economic security of any country is directly related to the level of development of transport systems. This level is one of the main conditions for preserving the unity of the economic space and stabilizing the socio-economic situation in the state. The development of transport systems increases the connectivity of the regions and ensures timely delivery of goods. The accessibility of transport and the growth of the average transportation distance indicates the expansion of the scope of transport activities and a factor of economic growth in the countries. Transport investments contribute to the formation of a unified network for the delivery of goods from supplier to consumer.

The development of transportation networks is contributing to positive effects:

- -increasing the level of development of the regions;
- -increasing the number of jobs and employment of the population;
- -increasing the accessibility of production to material and natural resources;
- -reducing the cost of production and, consequently, the cost and final total costs of the produced goods for the consumer.

The efficient use of all types of transportation ensures high quality and competitiveness of the transport industry as a whole. Competition between transport companies and modes of transport gives a great impetus to economic development both domestically and abroad. Due to the emergence of new threats to economic security in transport, companies and the state should work on the sustainable and safe functioning of the transport complex, namely:

- rational construction of the corporate organizational and production structure;
- implementation of innovative activities;
- the monitoring of potential threats;

- the provision of the enterprise with the necessary labor resources and their rational use;
- assessment of the work of management structures.

Freight transport is an important part of the functioning of any modern society. Thanks to them, goods are delivered from the manufacturer to the end consumer. The relationship between supply and demand for transportation can be considered as the basis for building a strategy for the development and scaling of supply chains.

The transport complex includes railway, air, sea, inland waterway, pipeline and automobile transport. Each type has its own peculiarities in the transportation of goods.

2. Literature review

In the modern literature, there is no single and universally accepted definition of economic security. Researchers interpret it as a state of sustainable economic development, as the ability of the economy to confront internal and external threats, as a system of protecting national economic interests. Modern authors emphasize that economic security is a key element of national security and a necessary condition for the stable development of the state, especially in conditions of crises (pandemic, war, etc.).

Several key trends can be identified in the literature. At the macroeconomic level, research focuses on the sustainability of economic growth, the role of the state in protecting the economy, and the universality of technology. At the level of regional security, researchers analyze differences in the level of security of regions, as well as the influence of institutional factors. At the enterprise level, the main focus is on financial stability, risk management, and overall enterprise performance.

In the scientific literature one can find different interpretations of the category “economic security”. Thus, L. Abalkin defines economic security as “a set of conditions and factors that ensure the independence of the national economy, its stability and sustainability, the ability for constant renewal and self-improvement” (Abalkin, 1994).

A. Arkhipov, A. Gorodetsky and B. Mikhailov believe that “economic security is the ability of the economy to ensure the effective satisfaction of social needs at the national and international levels, ... a set of internal and external conditions conducive to the effective dynamic growth of the national economy, its ability to satisfy the needs of society, the state, the individual, to ensure competitiveness in foreign markets, guaranteeing against various types of threats and losses” (Arkhipov, Gorodetsky & Mikhailov, 1994).

The team of authors under the leadership of academician V.K. Senchagov put forward the idea that the basic state strategy of economic and overall national security should be an ideology of development that takes into account strategic priorities, national interests, as a result of which security threats are minimized. Without the ideology of development, without the cultivation of industrial and scientific and technical development, it is impossible to solve such problems of economic security as increasing budget revenues, ensuring an acceptable level of employment of the population, improving the quality of life and social protection of the population. Therefore, the main goal of the economic strategy is to restore economic growth in Russia” (Senchagov, 1998)

In addition, V.K. Senchagov in his work puts forward the opinion that “security is the state of an object in the system of its connections from the point of view of the ability for self-

survival and development in conditions of internal and external threats, as well as the action of unpredictable and difficult to predict factors” (Senchagov, 1998).

According to V.L. Tambovtsev, “...the economic security of a particular system must be understood as a set of properties of the state of its production subsystem, which ensures the possibility of achieving the goals of the entire system” (Tambovtsev, 1995). This author also examines the activities of the enterprise in an unstable economic environment. He comes to the conclusion that “by economic security we will understand such a state of the subject in which the probability of undesirable change in any of the qualities of the subject itself, the parameters of its property and the external environment affecting it is small (less than a certain limit)” (Tambovtsev, 1995).

In the studies of D. Kovalev, the economic security of an enterprise is defined as “the security of its activities from the negative influences of the external environment, as well as the ability to quickly eliminate various threats or adapt to existing conditions that do not negatively affect its activities” (Kovalev, 1998). A number of other researchers and economists have a similar position.

Thus, V.V. Shlykov considers economic security as “the state of protecting the vital interests of an enterprise from real and potential sources of danger or economic threats” (Shlykov, 1999). An interesting position on the issue under study is also taken by a number of other authors, who relate the concept of economic security not only to an economic entity, but also to other institutions and the state as a whole.

V.I. Yarochkin notes that “security is the state of protecting the vital interests of an individual, enterprise, state from internal and external threats, and the general goal of economic security is to evaluate the results achieved and to identify reserves for increasing the production efficiency of an economic entity” (Yarochkin, 2005). Some researchers narrow the range of issues when considering this problem of economic security and focus on a certain number of problems.

So, B.A. Raizberg believes that “economic security is the prevention of leakage of confidential economic information from a company, violation of trade secrets, and economic sabotage” (Raizberg, 1996). This position has now become very relevant for business entities and the state as a whole when ensuring economic security, which is due to the rapid development of information technology and the emergence of the need to preserve confidential information. The concept of economic security now needs to include such a component as information security.

Thus, based on the considered approaches and points of view on the category of economic security, it follows that today a unified approach to revealing its essence has not been formed and its economic content has not been clearly defined. Each of the listed approaches complements each other, and different criteria to a certain extent may dominate in determining the essence of economic security. Such a change in the significance of the criteria and components of economic security depends on the specifics of specific companies, that is, the characteristics of their activities, the industry in which they operate and other factors.

Taking into account the considered scientific points of view regarding the phenomenon of economic security and the category of economic sustainability, the category “economic security of an economic entity” should be defined as an inherent characteristic of the

functioning of an organization, ensuring economic independence, sustainability, development with the efficient use of resources, minimizing threats to the main components of the stability of an economic entity.

A number of works emphasize the important role of the transport industry in ensuring economic security. In particular, it is emphasized that transport ensures the connectivity of the economy and the functioning of markets, and the sustainability of transport directly affect the economic security of the state. At the same time, disruptions in the transport system can lead to significant economic losses. There is also a close connection between the economic and financial security of transport enterprises, which makes them a key element of the overall economic system.

3. Methodology

When conducting a statistical study of the contribution of transport to the economic security of the country, it is reasonable to consider the following as the main tasks: determining the key indicators of the transport sector, assessing the impact of transport on macroeconomic parameters, identifying risks in the transport sector, conducting a comparative analysis of the dynamics of the indicators.

To analyze the problems of economic security, it is necessary to use the following groups of indicators: economic (share of transport in GDP, volume of cargo and passenger turnover, investments in transport infrastructure), safety indicators (level of accidents, degree of deterioration of infrastructure, dependence on external supplies), external economic indicators (the role of transport in export and import, the country's transit potential).

National statistical services, in particular those of Moldova, reports of transport companies, in particular the Russian Railways, data from articles are used as data sources for this study.

Methods of research on this topic include calculation of average values, growth rates, dynamics of indicators, inter-country analysis, qualitative assessment of the dependence between the development of transport and economic security, and expert assessments.

4. Results and discussion

Development of the transport sector in the Russian Federation

The current statistics of Russian transport are presented in Tables 1 and 2. Railway transport occupies one of the leading places in the system of transport communications in Russia, since the main flow of transportation for the principal industries is carried out using this type of transport.

Railway transport is in demand due to the efficiency of long distance transportation (typical for Russian logistics, where the places of manufacturing of many goods are far from the places of mass consumption), as well as due to financial benefits. In Russia, the delivery of goods by railway is of particular importance in economic development. This method of transportation is suitable both for sending large-sized products from one client and for assembled goods of different sizes from several customers. (Zhakov, 2018).

Table 1. Freight turnover in the Russian Federation by mode of transport (billion ton-kilometers)

	1992	2000	2010	2015	2020	2022	2023	2024	2025
Transport total	4913	3638	4676	4752	5108	5198	5488	5678	5401
Including by type:									
Railway	1967	1373	1858	2011	2306	2344	2493	2602	2545
Automotive	257	153	194	199	247	248	255	275	272
Pipeline	2146	1916	2474	2382	2444	2489	2615	2686	2470
Water transportation	541	193	147	154	106	110	117	107	107
Air transportation	1,8	2,5	2,8	4,7	5,6	6,6	7,9	7,4	7,1

Source: Korisheva, 2018, pp. 241-250.

Table 2. Freight turnover in the Russian Federation by mode of transport (as a percentage of the total)

	1992	2000	2010	2015	2020	2022	2023	2024	2025
Transport total	100	100	100	100	100	100	100	100	100
Including by type:									
Railway	40,04	37,74	39,73	42,32	45,14	45,09	45,43	45,83	47,12
Automotive	5,23	4,21	4,15	4,19	4,84	4,77	4,65	4,84	5,04
Pipeline	43,68	52,67	52,91	50,13	47,85	47,88	47,65	47,31	45,73
Water transportation	11	5,3	3,14	3,24	2,07	2,12	2,13	1,88	1,98
Air transportation	0,04	0,07	0,06	0,1	0,11	0,13	0,14	0,13	0,13

Source: Korisheva, 2018, pp.241-250.

Transportation by rail is multifunctional and is used for transporting raw materials and goods with virtually any characteristics, such as, volume-mass indicators, requirements for containers and packaging of cargo, temperature conditions, etc. Also, the advantages are low costs compared to the use of other modes of transport, high carrying capacity of wagons, independence from weather conditions, delivery of goods at the right time.

The main negative environmental factors inherent in railway transport are:

- solid waste;
- thermal radiation;
- strong vibrations.

Taken together, the last two have a detrimental effect on living beings. At the same time, railway transport is one of the most environmentally friendly modes of transport. However, the long-term development program of the Russian Railways (RZD) plans for large-scale electrification of routes that still operate using diesel fuel. This trend will reduce diesel consumption by 440 thousand tons per year and, as a result, reduce gas emissions to the atmosphere by 1,5 million tons. It is also planned to switch to natural gas, because according

to statistics, gas-powered locomotives emit 5 times less harmful substances into the atmosphere. (Bryk & Golikova, 2018).

In general, the share of freight turnover of railway transport in Russia is very significant. As can be seen from Table 2, in 1992 it was 40% and by 2025 it has increased by 7%.

The growth in cargo turnover over the past decade is associated with the following factors:

- modernization of the railway infrastructure, including the Trans-Siberian and Baikal-Amur roads;
- development of transportation and throughout capacities;
- transfer of the infrastructure of Sakhalin Island to the all-Russian track of 1520 mm;
- the start of work on the construction of the northern latitudinal railway;
- renewal of freight and passenger trains.

An increase in transportation distance not only indicates greater accessibility for transportation, but also savings on freight charges, as well as the consolidation of factories and a reduction in the cost of cargo. All of these factors have a positive effect on the economic security of the country.

The main competitor of railway transport is pipeline transport. Its share has hardly increased during the period under review. The development of pipeline transport is inseparable from the development of the oil and gas industry, and, consequently, from the development of the country's economy. A significant part of the Russian state budget is provided by revenues from the extraction and export of minerals. Pipeline transport has great development prospects associated with growing demand for oil and gas resources. The advantage of this type of transport is minimal investment in cargo transportation, minimal human resources, creation of the shortest delivery route and less time for pumping products.

Automobile transport in Russia takes only the third place in terms of cargo turnover, and with a tenfold gap from the leading types of transport. This backwardness is characterized by the underdevelopment of the road network typical for the northern and eastern regions of Russia. This directly affects the economic security of these regions, depriving them of the echeloning of freight and passenger transport. In many regions or important points in the north and east of Russia, goods have to be delivered by air, which significantly affects the availability of goods for the local population and business.

At the same time, it is obvious that the main advantage of this type of transport is its accessibility to places of delivery of goods, as well as its convenience in the delivery of oversized goods over short distances.

Air transport has a negative impact on the environment due to the combustion products of aviation fuel, as well as high noise levels. These are undoubtedly factors reducing economic security. Developers in the world's most technologically advanced countries are working on electric planes, but only small private passenger planes have been built so far. Electric aircraft is not considered to be completely environmentally friendly, as the production and disposal of batteries pollutes the environment.

Airbus company presented the Smart Sky aviation development project. According to forecasts, by 2050 aircraft with mixed engines will be used. Airports will stop using internal

combustion engines, even on the ground. All this will help to reduce emissions into the atmosphere. (Tereshina & Sokolov, 2019).

The state of aviation transport in Russia in 2025-2026 cannot be considered satisfactory. The Russian aircraft fleet largely consists of foreign equipment and, accordingly, depends on imported components – about 80% of aircraft in Russia are foreign-made, helicopters – more than 10%. In February 2022, Russian air carriers were prohibited from buying foreign vessels and spare parts. Foreign leasing companies demanded the return of aircraft that were under operating lease. This poses serious risks to flight safety and reduces the economic efficiency of air transport.

Russia's own aircraft production is very insignificant (Businesstat, 2025). In particular, according to the "Analysis of the aircraft manufacturing market in Russia", prepared by BusinesStat in 2025, the production of civil aviation equipment in Russia amounted to 166 aircraft and helicopters, which is 13% lower than the previous year. Aircraft production in the country has been declining throughout 2023-2024 (see Figure 1).

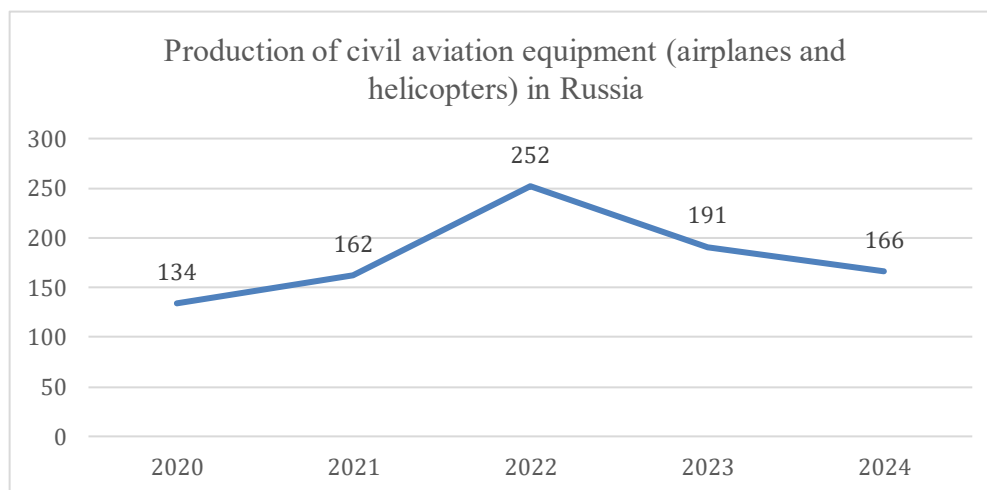


Figure 1. Production of civil aviation equipment in Russia, 2020-2024

Source: <https://marketing.rbc.ru/articles/15857/>

Consequently, the contribution of aviation to Russia's economic security is now extremely insignificant. Water transport (sea and inland waterways) provides transportation of goods in the areas directly gravitating to internal water routes, as well as mixed transportation of foreign trade goods. The use of hybrid transportation in many cases contributes to savings in transportation costs of the national economy and in foreign currency for foreign trade transportation.

River transport in the modern Russian economy accounts for less than 2% of the volume of transportation, which is significantly lower than in the planned economy in the USSR. This type of transportation is used in the case of transporting goods that do not require rapid delivery: construction materials (sand, gravel, etc.), coal, grain, etc. This is due to the fact that the speed of river vessels is limited to 10-20 km/h.

The duration of navigation on most Russian waterways is about six months, so cargo owners have to adjust the logistics of cargo transportation. Infrastructure constraints and declining water levels in recent years have led to a record drop in Russia's river freight traffic. In addition, the situation is getting worse every year, which leads to an urgent need to update the fleet.

This situation indicates a critically low level of economic security in regions of Russia located along waterways and at the same time with poor transport accessibility of railways and roads (Krasnoyarsk Territory, Khanty-Mansiysk District, Perm Territory, Irkutsk Region, Yakutia, many others).

Development of the transport sector in the Republic of Moldova

If, when analyzing the development of the transport systems in the Russian Federation, we were dealing with the largest country in terms of territory, then when analyzing a similar situation in the Republic of Moldova, we must take into account both the modest size of the country (approximately 34 thousand sq.km.) and only 2,5 million population.

Table 3. Freight transportation in the Republic of Moldova

Freight transportation	2023	2024	2025
Freight transported, mln.tons	19,8	20,2	20,6
Including by types of transport:			
By railway	1,55	2,5	2,3
By automotive	18,1	17,6	18,3
By water	0,1	0,1	0,1
By air	0,01	0,01	0,01
Freight transportation, mln. ton-kilometers	5844	5964,7	5150
Including by types of transport:			
By railway	660	503,6	492
By automotive	5183	5459,7	4657
By water	0,3	0,3	0,3
By air	1,1	1,1	1,3

Source: National bureau of statistics of the Republic of Moldova. <https://statistica.gov.md/>

Data from the National Bureau of Statistics of the Republic of Moldova (Table 3) indicate that the main type of freight transport in the Republic of Moldova is automotive transport. And this is despite the presence of 1156 kilometers of railway tracks connecting most of the country's industrial centers! (National bureau of statistics of the Republic of Moldova, 2026)

The reasons for such poor use of railways are:

- outdated infrastructure powered exclusively by diesel locomotives (electrification of a small number of kilometers on the border with Romania started only at the end of 2025);
- the need for reconstruction;
- low speeds.

It is characteristic that in passenger traffic the railways have an extremely low indicator from year to year. For example, in 2024 they carried only 5% of the total intercity passenger traffic (see Table 4).

From the data in Tables 3 and 4, it is obvious that almost the entire burden of both freight and passenger transportation in the Republic of Moldova currently falls on automotive transport. This imbalance in transportation is an obvious threat to economic security for the

Republic of Moldova. For example, under unfavorable weather conditions, road transport is unsafe or completely impossible, and railway transport, which is much less sensitive to weather conditions, is virtually inactive.

Table 4. Passengers turnover in Republic of Moldova by means of transport [6]

	Turnover, million passenger-kilometers				
	2020	2021	2022	2023	2024
Total, including:	166,6	159,9	213,5	288,6	364,0
railway	29,2	23,3	32,0	58,9	51,0
buses	137,0	136,3	181,2	229,4	312,7
river	0,4	0,3	0,3	0,3	0,3

Source: National bureau of statistics of the Republic of Moldova. <https://statistica.gov.md/>

This state of transport in the Republic of Moldova threatens the entire economic and logistics chain of the country and hinders economic growth, which, by the way, is only 0,1% for 2024 and 1,3% for 2025 (Monitorul fiscal, 2025). Due to the underdevelopment of transport infrastructure, various risks arise, for example, the weather and climatic risks already mentioned above, when freight or passenger transportation is provided by only one type of transport. Economic security is ensured by *echeloning* of transportation, that is, the presence of at least two modes of transport in each principal economic point. In the Republic of Moldova, this has not been implemented primarily due to the underdevelopment of railway transport.

Obviously, the intensive development of railway transport in the Republic of Moldova requires significant investments. In current economic conditions, this can only be external investment, primarily from European partners. Such investment is actually implemented (Trading Economics, 2026). In particular, the Republic of Moldova is taking an unprecedented step in modernizing its railway infrastructure by building the first electrified railway with European gauge (1435 mm) on the Chişinău-Ungheni section (104 km). This line will run parallel to the existing 1520 gauge line using diesel locomotive traction. The implementation of this project will provide a direct connection between Moldova and the modern European railway network. Advantages of this investment project:

- faster (maximum speed planned to be up to 140 kilometers per hour) and safer trips for passengers in modern comfortable conditions;
- stimulating cross-border trade and transport links by simplifying the transport of goods to the European Union;
- integration of the Republic of Moldova into the main network of the European Union TEN-T, which will increase economic competitiveness and investment attractiveness.

The feasibility study for the project is supported by the Eastern Partnership Investment Fund (EPIC), an initiative promoting the development of sustainable infrastructure and the expansion of the European transport network.

The new Chişinău-Ungheni line will not only be a technical innovation for the national railway infrastructure, but also a strategic project that will bring the Republic of Moldova closer to European transport standards. Thanks to this investment, the country will benefit

from direct and efficient connections with European Union member states, which will improve both citizen mobility and long-term economic prospects (Moldpress.md, 2026).

5. Conclusions

Economic development directly depends on the degree of transport development. By connecting regions, delivering various goods and carrying passengers, transport improves the quality of life of the country's population. By ensuring transport accessibility to production sites, it increases the efficiency of their use, creates opportunities to increase the volume of goods produced and reduce additional transportation costs, and, consequently, creates the basis for reducing the cost of goods for consumers.

The main specificity of the transport complex of almost any country is the leading role of mainline railway in serving the real sector of the economy, which determines its role and significance in the formation of national economic security.

Within the country, the development of the transport system indicates the level of accessibility of various regions of the country, the provision of resources to them, and the feasibility of developing production capacities. And on the basis of this, we can analyze and forecast economic activity and the further organization of freight transport. Also, improving transport infrastructure helps to expand trade and develop cooperation between countries and their competitiveness.

Considering the importance of the transport system presented above, and especially the railway industry, we can reasonably talk about the decisive role of transport in the formation of national economic security and economic development. The importance of railway transport in the transport market is due to factors such as: versatility, carrying capacity, safety and technical equipment level.

These factors determine the importance of railway transport for any country: large like Russia or small like Moldova. In each country, this type of transport creates the basis of the transport system, providing, more or less qualitatively, the needs of citizens, companies and the state in transporting passengers and goods. Modern transport in general is a socially significant sector of the economy, which is a necessary element of the infrastructure of modern society.

The effective functioning of transport systems is the basis for the integrity of national security and the defense capability of the state. In addition, by modernizing them, the country significantly increases sustainability and stimulates economic growth, which directly affects the standard of living of the population.

Taken together, all types of transport, fulfilling their function, form the "blood supply system" of the economy, the general foundation for economic development, thereby ensuring and increasing economic security.

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THE TEACHER AS A COMMUNITY INFLUENCER: THE MECHANISM FOR CONVERTING PEDAGOGICAL VOCATION INTO ECONOMIC VALUE

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Abstract: Education is one of the main factors of economic development, and teachers play a central role in shaping the human capital of a community. This paper analyzes the role of teachers as community influencers and proposes a conceptual and mathematical model to explain the mechanism through which pedagogical vocation generates indirect economic value. Based on human capital theory and the literature on knowledge spillovers, the paper argues that the teacher's vocation influences the quality of education, the level of students' skills, and their economic behaviors. A simplified mathematical model is proposed that quantifies the economic surplus produced by the vocation of teachers through the increase in students' human capital. It also discusses examples from communities in Romania where educational institutions have contributed to local economic development. The results suggest that teaching vocation can be interpreted as a factor generating community intellectual capital, with significant long-term economic effects.

Keywords: teaching vocation, human capital, community influence, education, economic development, knowledge spillover.

Classification JEL: I25, A0, Q01.

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1. Introduction

Education is often regarded as a pillar of economic development, but insufficient emphasis is placed on the teaching profession as a key factor in this process.

When decision-makers and the academic community address the issue of raising educational standards and evaluating educational effectiveness, the focus tends to fall primarily on: infrastructure and technology (modern schools, laboratories, computers, interactive whiteboards, etc. - investments in tangible resources are visible and easy to justify financially); measurable academic performance (results on standardized tests - PISA, national exams - graduation rates, and statistics on access to higher education); curriculum and competencies (emphasis on adapting programs to labor market demands, preparing students for economic fields considered strategic - STEM, digitalization); educational policies and management (national plans, curriculum reforms, performance standards; system evaluation relies more on reports and statistics than on direct pedagogical observation).

All elements related to the teaching vocation are neglected:

- Teacher dedication and passion: A passionate teacher can completely transform the educational experience, but this aspect is difficult to measure.

- Emotional intelligence and the ability to motivate: The impact of a teacher who inspires and cultivates curiosity is enormous, but difficult to quantify.
- Creativity in teaching and adaptability to students' needs: The standard curriculum does not always reflect how a teacher can personalize learning.
- Development of a positive educational culture: The teacher-student relationship, classroom climate, and values such as empathy and responsibility are undervalued.

This neglect of the teaching vocation is due to a combination of complex factors - political, social, but especially economic.

I list a few of these factors as examples:

- Public policies and funding are geared toward quantifiable results.
- Society views economic success through concrete outputs (employability, salaries, technical skills).
- The teaching vocation is an intangible factor, difficult to standardize and evaluate through statistics.
- Passionate teachers are often underappreciated or do not receive resources for continuous professional development.

Although investment in infrastructure, curriculum, and technical skills is necessary, the teaching vocation remains the key factor that makes education effective and sustainable in the long term. A lack of recognition of this vocation can lead to systems that are “high-performing on paper” but fail to produce creative, responsible, and motivated individuals.

In this paper, we propose a theoretical model that describes how a teacher's vocation influences the economy through the formation of human capital. We will analyze the mechanism through which teachers' dedication and commitment to education translate into increased student competencies, which subsequently translate into economic value at the individual and societal levels. The main objective of this paper is to show that the teaching vocation can be viewed as a valuable economic resource, having a significant impact on the economic development of the community.

2. Literature Review

2.1 The Teaching Vocation in the Educational Context

In the literature, the teaching vocation has been viewed primarily from psychological and pedagogical perspectives, defined as a form of deep dedication to education and to students. Many authors argue that vocation influences both the quality of teaching and the interpersonal relationships between teachers and students (Bae, 2016). These relationships, in turn, contribute to a positive educational climate, which is essential for the harmonious development of students.

Although there is ample evidence regarding the impact of teacher quality on student performance (Chetty et al., 2014), very little research directly addresses the conversion of pedagogical vocation into economic value. Teaching vocation is often considered a trait that is difficult to measure economically, yet some studies suggest that quality education,

fostered by dedicated teachers, can lead to increased human capital and economic productivity in the long term (Hanushek, 2010).

However, more recent literature emphasizes that the teaching vocation can have significant direct and indirect economic effects. Some of the direct effects of the teaching vocation, as mentioned in the specialized literature:

- a) Improved quality of education;
 - Passionate teachers explain concepts more clearly, adapt teaching methods, and maintain students' interest;
 - Students acquire solid skills, ready to be applied in the labor market.
- b) Reduced school dropout rates;
 - Students are more motivated to attend school and complete their studies.
 - More graduates mean more human capital for the economy.
- c) Development of key competencies
 - Creativity, critical thinking, problem-solving.
 - These skills increase productivity and innovation in companies and startups.

Furthermore, the specialized literature mentions countless indirect effects of the teaching profession:

- a) Long-term impact on innovation:
 - Inspired students become entrepreneurs, researchers, or professionals who generate new solutions;
 - Knowledge-based economies depend on people capable of thinking creatively and independently.
- b) Reduction of social costs
 - Quality education reduces the risk of unemployment, delinquency, and poverty.
 - Economically prosperous communities have fewer social problems, so they can focus on development.
- c) Improving the reputation of the education system
 - Countries with passionate teachers attract foreign investment and international talent.
 - A well-educated and motivated workforce is attractive to companies.

Thus, the teaching vocation should not be viewed merely as an individual trait, but as a structural factor in educational performance and long-term economic development, whose importance extends beyond the mere allocation of resources or performance on standardized tests.

Traditionally, the economic analysis of education has focused on the number of years of schooling and the material resources allocated to schools, neglecting factors such as teacher motivation and dedication. However, recent research suggests that teaching as a vocation can have significant economic effects,

A compelling example is the study by Chetty et al. (2014), which shows that good teachers have a direct impact on the long-term success of their students, including higher wages, employment rates, and quality of life. These benefits, although often difficult to quantify at the macroeconomic level, are reflected in increased productivity and reduced social costs associated with inefficient education.

2.2 Human Capital and the Impact of Education on the Economy

The theory of human capital, formulated by Gary Becker (1993), suggests that education is an investment that increases individuals' long-term productivity and income. According to this theory, education is not merely a process of accumulating knowledge, but a form of investment in skills that can improve the efficiency of economies. Thus, the vocation of teachers can be understood as an additional factor contributing to the effectiveness of education, improving the efficiency of the learning process and, implicitly, the long-term economic value of students. Dedicated teachers not only impart knowledge but also inspire and shape behaviors that contribute to the full development of students' potential.

In this sense, the teaching vocation can influence human capital not only by creating a stimulating educational environment but also by fostering essential skills that determine students' professional and personal success. This approach is supported by recent research showing that quality education has a direct impact on economic productivity, employment rates, and individuals' standard of living in the long term.

Studies by Raj Chetty (2011) have demonstrated that good teachers can increase a student's long-term income by up to \$50,000, thanks to improvements in their skills and economic performance. This research suggests that teachers' dedication influences not only the educational process but also students' individual economic outcomes. Thus, the teaching vocation not only builds cognitive skills but also contributes to the development of socio-emotional traits that influence graduates' economic behaviors.

In addition to these observations, it is important to note that quality education, supported by passionate teachers, plays a crucial role in reducing economic inequalities. Education not only improves employment opportunities but also helps create a workforce that is more innovative and adaptable to the demands of a dynamic economy. In this context, the teaching profession becomes a key factor in reducing economic disparities and ensuring sustainable economic development.

Furthermore, recent research suggests that investments in education not only improve individuals' professional skills but also establish a virtuous cycle in which each generation of dedicated teachers contributes to building a more resilient and equitable economy. Additionally, economic research on human capital emphasizes that to maximize the economic returns of education, it is essential to support the continuous development of the teaching profession, as well-trained and motivated teachers have a significant impact on overall economic success.

2.3 The Economics of Education and the Impact of Teachers on National GDP

Macroeconomic studies, particularly those conducted by Hanushek (2010), suggest that improving the quality of education can contribute significantly to national GDP growth. According to the human capital growth model, education plays a fundamental role in labor force development and economic productivity growth. According to this model, teachers' vocation can be seen as a factor that enhances human capital formation by creating a more

effective and stimulating learning environment, which contributes to the development of students' economic competencies.

Furthermore, teachers' pedagogical vocation has an impact on the educational process that goes beyond the mere transmission of knowledge, extending to the development of socio-emotional skills, which are essential for adaptability and innovation in the labor market. In this context, vocation becomes a catalyst for improving human capital, which, in turn, is reflected in long-term economic growth.

Recent research has shown that dedicated teachers directly contribute to increased economic productivity, serving as a key factor in workforce quality. For example, a study by Chetty et al. (2014) shows that good teachers can significantly increase students' long-term income, which translates into long-term growth in national GDP through increased individual productivity and public revenue.

Thus, the teaching profession not only influences a nation's level of education but also has direct effects on the national economy through increased productivity, reduced economic inequalities, and improved economic mobility. Furthermore, investments in the continuing professional development of teachers and in supporting the teaching profession can generate a virtuous cycle of economic development, in which quality education contributes to the growth of sustainable and innovative economies.

3. Methodology

The process by which a teacher's vocation generates economic effects can be described by the following mechanism:

teacher's vocation → *educational quality* → *human capital* → *productive economic behaviors* → *community development*

Teachers with a vocation demonstrate a higher level of engagement in the educational process, which leads to improved academic performance among students and the development of their skills. In the long term, these skills translate into economic productivity and the community's capacity for innovation.

To analyze how teachers' vocation influences the economy, we proposed a simplified economic model that integrates several variables. The model is based on the following assumptions:

- a) S (students' skills) depends on the teacher's vocation (V), educational resources (F), the family environment (M), and the additional time devoted to education (T).

The formula for students' skills is:

$$S = S_0 + \beta_1 V + \beta_2 F + \beta_3 M + \beta_4 T \quad (1)$$

where:

S_0 represents the initial level of competencies, without the influence of vocation.

$\beta_1, \beta_2, \beta_3, \beta_4$ are coefficients that measure the impact of vocation, resources, family environment, and additional time on student competencies.

Student competencies consist of two parts:

- competencies that would emerge anyway;
- plus the effect of the teacher's vocation.

Therefore: student skills = basic skills + the effect of vocation

- b) Students' economic income (Y) is a function of the skills acquired:

$$Y = Y_0 + \alpha S + \gamma E + \delta X \quad (2)$$

where:

Y_0 is the student's base income (without additional education).

α , γ , δ are coefficients reflecting the impact of skills on income (S), professional experience (E), and additional education (X).

In economics, there is a simple rule: more skilled people produce more and earn more. Therefore: economic income = base income + the effect of skills

- c) The economic impact of the vocation is expressed by:

$$\Delta Y = \alpha \beta_1 V \quad (3)$$

where:

ΔY is the increase in income due to the teacher's vocation

α is the coefficient showing how much income increases when skills increase

β_1 is the coefficient measuring the impact of the vocation

By integrating these formulas, we can estimate the increase in income and the economic impact generated by the teacher's vocation in the long term.

- d) The model can be scaled up to the national level. For example, if we want to calculate the total impact of teachers' vocation on a country's economy, we could use the following formula:

$$It_n = \sum (N_i + \Delta Y_i) \quad (4)$$

where:

It_n total national impact

N_i the number of students taught by teacher i

ΔY_i the increase in income generated by the students taught by teacher i

In this way, we can estimate the economic impact of teachers' vocation on the national economy.

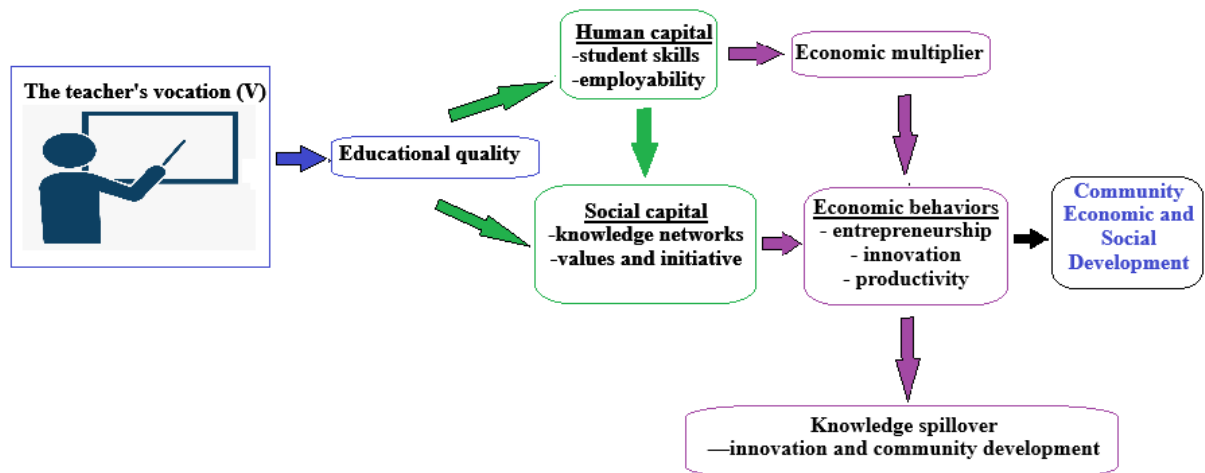


Figure 1. Conceptual model of the conversion of the teaching vocation into economic value: a teacher's vocation enhances the quality of the educational process, which leads to the development of students' human capital, influences economic behaviors, and generates economic benefits at the community level.

The proposed model seeks to highlight the following:

- a dedicated teacher enhances students' skills.
- more skilled students earn higher incomes in the economy.

Therefore, a teacher's dedication generates economic value in society.

Good teachers → more competent students → a stronger economy.

The model is thus an attempt to demonstrate theoretically that teachers' dedication is not merely a moral value, but also a real economic factor. This mechanism is analyzed in many studies by the OECD and the World Bank.

4. Results and Discussion

By applying the proposed model, we observed that teachers' vocation has a significant impact on students' competencies and, consequently, on their long-term earnings. Specifically:

- Teachers' vocation (V) has a high coefficient ($\beta_1 < 1$), indicating that an increase in this factor leads to a significant increase in students' competencies. This is explained by the fact that, under the same conditions regarding educational resources (F), family environment (M), and time devoted to education (T), the teacher's vocation makes the difference.
- The human capital generated by education increases labor productivity, which translates into an additional economic income of approximately 30,000 euros per student, according to economists' estimates (Chetty, 2014).
- Furthermore, teachers' vocation contributes to the growth of national GDP by fostering more productive human capital. The simplified model suggests that the

teaching profession can generate millions of euros in economic value for an entire community by producing better-prepared students.

These results suggest that dedicated teachers can directly influence the economy by improving student performance, which leads to increased individual incomes and, consequently, to the economic progress of society.

5. Conclusions

The proposed model is a simple theoretical model, inspired by human capital theory, which I consider conceptually sound but which needs to be expanded for empirical research. This paper has demonstrated that teaching vocation is an essential economic factor that influences not only the quality of education but also the national economy. Teachers with a strong vocation generate high-quality human capital, which, in the long term, translates into increased income and economic productivity.

It is clear that investments in quality education and support for teachers not only improve educational outcomes but also contribute to the community's sustainable economic growth. In the future, research can expand this model to include additional factors and more accurately measure the long-term impact of teachers' vocation on the economy.

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CONCEPTUAL FOUNDATIONS OF ESG INTEGRATION IN MODERN BUSINESS MODELS

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Abstract: *The ESG criteria have shifted decisively from the periphery of investment theory to the centre of corporate strategy, regulatory design, and academic inquiry. Yet the conceptual architecture underlying ESG integration remains imprecisely theorized. The framework is widely applied in practice, whereas its theoretical foundations remain subject to ongoing academic debate. This paper examines the intellectual underpinnings of ESG integration within modern business models, tracing its origins across stakeholder theory, institutional economics, and strategic management, while mapping the mechanisms through which ESG factors generate (or fail to generate) long-term enterprise value. Drawing on an integrative review of theoretical and empirical literature, this study articulates a multi-dimensional framework that distinguishes strategic, operational and reporting dimensions of ESG adoption. The study critically examines structural challenges including rating divergence, greenwashing, and the time-horizon mismatch between genuine sustainability transformation and the temporal logic of contemporary capital markets. It contributes a conceptually coherent account of ESG integration suited to the demands of contemporary scholarship and business practice alike.*

Keywords: *ESG integration, stakeholder theory, double materiality, sustainable business models, value creation, corporate governance.*

Classification JEL: *M14, G30, Q56, L21, K20.*

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1. Introduction

Something has shifted in how the relationship between business and society is understood – not merely in activist circles or policy documents, but in the analytical frameworks that investors, strategists, and regulators bring to enterprise evaluation. ESG criteria once limited to the terrain of ethical investment, now permeate capital allocation decisions managing considerable amounts of financial resources worldwide, inform mandatory disclosure regimes across major jurisdictions, and increasingly determine the terms on which enterprises access talent, supply chains, and financial markets. The convergence of these forces has happened faster than most commentators predicted.

This rise has been rapid, and its conceptual foundations have not always kept pace with its practical spread. The term ESG entered institutional discourse formally through the 2004 report “Who Cares Wins”, developed under a UN Global Compact-led, multi-institutional financial sector initiative (United Nations Global Compact, 2004), but the ideas it organises draw on decades of prior theoretical work. This prior theoretical work is related to stakeholder relationships, corporate governance, institutional pressures, and the social embeddedness of economic activity. The ESG framework has been widely taken up in practice, even as academic debate continues to explore its conceptual scope. The difference in emphasis between application and theory is an important context for understanding its development. Without a clear account of what ESG integration actually means – how it creates value, through which mechanisms and under what conditions – the concept risks

dissolving into rhetorical performance: the right language spoken over business models that have not fundamentally changed.

This paper addresses three connected questions. First, what are the theoretical foundations from which ESG integration draws its conceptual coherence? Second, through which mechanisms do ESG factors translate into enterprise value? Third, what structural challenges prevent integration from advancing beyond disclosure?

The paper proceeds as follows. The literature review provides an overview of the theoretical literature situating ESG within its intellectual lineage. The following section describes the methodology applied. The results and discussion section develops the integrative framework and examines value creation mechanisms and structural challenges. The paper presents the conclusions in its last section.

2. Literature Review

Theoretical foundations

ESG integration does not emerge from a single intellectual tradition. Its conceptual coherence derives from the convergence of several distinct theoretical strands, each contributing to a dimension that the others alone cannot provide.

One of the most influential challenges to the shareholder-centered models of the firm, that ESG implicitly contests come from Freeman's (1984) stakeholder theory. The proposition that firms are embedded in webs of obligation extending to employees, communities, suppliers, customers and the natural environment, and that managing these relationships well is not merely an ethical preference but a strategic necessity. Freeman's framework reoriented corporate purpose away from Friedman's (1970) narrow formulation that suggested that the social responsibility of business is to increase its profits. It moved towards a pluralistic account of value creation that ESG frameworks operationalise, imperfectly but recognisably. The difference between these two positions is not only a matter of wording; it reflects differing views on where corporate accountability ultimately lies.

Institutional theory, particularly DiMaggio and Powell's (1983) account of isomorphic pressures, explains why firms adopt ESG practices even when the financial case is ambiguous or contested – a phenomenon that purely rational choice models cannot adequately account for. Coercive pressures, rooted in regulatory requirements, compel adoption when law mandates it. Mimetic pressures drive adoption when firms emulate industry leaders navigating uncertain environments. Normative pressures operate through professional standards, industry associations, and educational institutions that collectively shape what responsible management is understood to mean. These three mechanisms explain the breadth of ESG adoption across sectors and geographies far more convincingly than financial incentives alone.

The resource-based view (Barney, 1991) adds a further analytical layer, specifically the ESG capabilities. These capabilities, which include organisational routines, measurement systems, stakeholder networks and governance structures that support genuine sustainability integration can also constitute sources of sustained competitive advantage when they are valuable, rare, difficult to imitate and non-substitutable. This reframing moves ESG from the domain of compliance and ethics into the domain of strategic management, with significant implications for how integration should be designed, resourced, and evaluated.

Mayer's (2018) concept of purposeful capitalism extends these arguments to questions of corporate purpose itself. The EU's Corporate Sustainability Reporting Directive (CSRD) gives them regulatory force for its operationalisation of double materiality: the simultaneous assessment of how ESG factors affect enterprise value and how enterprise activity affects society. It represents a conceptual expansion of considerable importance.

Empirical evidence on ESG and performance

The empirical literature on ESG and financial performance is voluminous and on balance, broadly supportive of a positive relationship – even though with qualifications that careful reading reveals. The meta-analysis by Friede et al. (2015), synthesizing over 2000 primary studies, found that approximately 90% reported a non-negative ESG performance relationship, with the majority positive. That headline finding, however, masks considerable heterogeneity. Subsequent syntheses highlight that results vary substantially depending on methodology, ESG measurement and investment approach, with no consistent evidence of systematic outperformance (Atz et al., 2023).

Eccles et al. (2014) provide the most cited longitudinal evidence – high sustainability companies significantly outperform low sustainability peers on both stock market and accounting metrics over a long-term horizon. The evidence also indicated that high sustainability firms had more developed stakeholder engagement practices and were more likely to have longer term oriented investors. Khan et al. (2016) refine the question – performance on issues that are financially material to a given industry predicts future performance, while performance on immaterial issues does not. This finding suggests that the ESG-financial performance relationship is not generic but contingent – contingent on the relevance of specific ESG factors to specific business models or competitive contexts. The endogeneity problem, whether better-managed firms simply tend to score higher on both ESG and financial metrics remains unresolved and limits the strength of causal claims that correlational evidence can sustain.

Research gap

Despite the volume of ESG literature, theoretical fragmentation still persists. The three pillars are studied largely in isolation. The mechanisms connecting strategic intent, operational practice, and reporting outcomes are underspecified. At the same time, double materiality lacks systematic theoretical treatment in the management literature, despite its regulatory codification. This paper addresses those gaps by developing an integrative framework that brings these dimensions into coherent relation.

3. Methodology

This paper employs an integrative literature review methodology. The objective is not to conduct a systematic review in the technical sense, but to provide a theoretically guided synthesis and develop a conceptual framework in a domain where empirical research has proliferated faster than theoretical integration.

The literature base spans four decades of scholarship across strategic management, institutional economics, finance and sustainability science. Sources were selected on criteria of theoretical influence, empirical rigour, methodological transparency and relevance to the free analytical questions that organize the paper. Priority was accorded to peer reviewed articles in leading management and finance journals supplement by

regulatory documents, specifically the EU CSRD, and the European Sustainability Reporting Standards (ESRS), that constitute the primary institutional codification of ESG and sustainability concepts. Theoretical constructs were evaluated for internal consistency, explanatory scope and compatibility with observed patterns of ESG adoption across firm types and institutional contexts.

The analytical output takes three forms: a multidimensional integration framework distinguishing the strategic, operational and reporting dimensions of ESG adoption; a typology of five value creation mechanisms through which ESG performance translates into enterprise value; and a structured analysis of three structural challenges that prevent genuine integration from being reduced to disclosure performance. The framework is intended both as a conceptual contribution in its own right and as a foundation for subsequent empirical research employing enterprise-level surveys, longitudinal panel data, or comparative regulatory analysis.

4. Results and Discussion

The literature supports a conceptualisation of ESG integration operating across three analytically distinct but operationally interdependent dimensions: strategic, operational, and reporting. Genuine integration requires coherence across all three dimensions. The absence of any one dimension tends to undermine the credibility and effectiveness of the others – a proposition empirically observable in the divergence between companies that produce extensive ESG reports while not fully embedding ESG values into operational decisions, and those where sustainability is woven into the logic of business across all levels.

The strategic dimension concerns how ESG considerations are embedded in corporate purpose, long-term goal setting, and competitive positioning. Companies that define their purpose in terms of creating value for all stakeholders – rather than treating ESG as a constraint on the primary objective of shareholder return – create normative and organisational foundation on which integration at lower levels can be built. Without this anchor, ESG programmes tend to remain peripheral – specifically responsive to external pressure, overall episodic in application and reversible when performance pressures intensify. In the strategic dimension, the relationship between ESG and competitive advantage more visible. Porter and Kramer's (2011) shared value framework usefully argued that social and environmental challenges can be reframed as sources of competitive opportunity and innovation, rather than costs.

The operational dimension is where most ESG value is created or destroyed. Not in disclosure documents, but rather in the accumulated decisions of supply chain managers, product engineers, HR directors, and facilities teams. Here the tensions between short-term cost pressures and long-term value creation are most acute, and the absence of appropriate measurement systems most seriously impedes genuine integration. Energy and resource management, labour standards enforcement across supply chains, waste and water stewardship – these require investment in monitoring, systems and accountability that carries upfront cost and delivers returns on a horizon that quarterly reporting does not readily capture.

The reporting dimension concerns measurement, disclosure, and independent assurance. Standardised frameworks, such as GRI, SASB, TCFD or ESRS, have substantially improved disclosure comparability, though gaps still persist across jurisdictions and sectors. Double

materiality, codified in the CSRD and operationalised through ESRS, is the reporting dimension's most consequential development. By requiring disclosure of both financial materiality and impact materiality, the double materiality enacts a pluralistic conception of corporate accountability extending far beyond investors to encompass all affected stakeholders. Table 1 summarizes the integration framework developed in this paper. ESG integration is conceptualised as operating across three analytically distinct but operationally independent dimensions, and effective integration requires coherence across all three.

Table 1. Dimensions of ESG Integration in Modern Business Models

Dimension	Analytical role	Core management focus	Theoretical anchors	Risk of decoupling
Strategic	Defines the firm's purpose and long-term ESG orientation	Corporate purpose; stakeholder value creation; alignment of ESG long-term priorities with business model and competitive positioning	Freeman (1984); Mayer (2018); Porter & Kramer (2011)	ESG framed rhetorically but not embedded in organisational priorities. Reactive and vulnerable to reversal under short-term performance pressure
Operational	Embeds ESG into capabilities and business processes	Supply chain practices; workforce management, risk controls; resource efficiency; monitoring systems and incentives	Barney (1991)	Symbolic ESG commitments not translated into routines or resource allocation
Reporting	Externalises ESG through disclosure, comparability, and legitimacy	Double materiality assessment; alignment with global standards; third-party assurance; reporting transparency	DiMaggio & Powell (1983); Suchman (1995)	Disclosure-driven ESG: improved reporting quality with limited strategic or operational transformation

Source: Author's synthesis.

Value Creation Mechanisms

If ESG integration is to be understood as something more than a compliance requirement or reputational management exercise, a clear account of the mechanisms through which it generates enterprise value is essential. The literature identifies five distinct channels, each with a different risk-return profile and time-horizon. Genuine integration typically activates several channels simultaneously.

The first is risk mitigation. ESG management systematically addresses categories of enterprise risk that conventional financial analysis tends to underweight or ignore entirely: regulatory risk (the expanding perimeter of mandatory ESG requirements across jurisdictions), physical climate risk (the direct financial consequences of weather events, resource scarcity, and ecosystem disruption), and transition risk (the financial implications of decarbonisation policy, technology shifts and market reorientation). Carbon intensive assets face stranded asset exposure as emissions pricing tightens. Enterprises with poor labour practices face considerable litigation and reputational exposure. Governance failures correlate strongly with

fraud and misconduct. In this framing, ESG management could be perceived as advanced enterprise risk management applied to a broader and longer risk horizon – not a departure from shareholder value logic, but a more complete expression of it.

The second channel is cost reduction. Energy efficiency, waste minimisation, and water stewardship reduce operating costs directly and also measurably. As Luken and Saieed (2023) show, resource-efficiency measures related to energy, waste and raw materials lead to lower resource use and attractive payback periods, which refer to the time required for the financial savings generated by a resource-efficiency measure to cover its initial implementation cost. Their study therefore points to clear potential for operational savings.

The third is revenue enhancement. ESG positioning opens access to sustainability-premium market segments, public procurement conditioned on ESG performance and a growing universe of institutional clients that are facing their own mandatory ESG reporting obligations. There is also a focus on embedding sustainability criteria in supplier selection.

The fourth is capital access. Academic evidence suggests that credible green instruments can benefit from preferential pricing, especially when supported by external reviews, while voluntary sustainability disclosures and third-party assurance may also contribute to lower cost of capital (Dorfleitner et al., 2022; Martínez-Ferrero & García-Sánchez, 2017)

The fifth is human capital and organisational resilience. Firms with demonstrably strong social performance attract and retain talent more effectively, exhibit lower absenteeism and employee turnover, and demonstrate greater adaptability in conditions of operational disruption.

Structural Challenges to Genuine Integration

Acknowledging value creation mechanisms does not require ignoring the substantial obstacles that prevent ESG integration from transcending disclosure performance. Three deserve particular attention.

Rating divergence is the first. Berg et al. (2022) document a mean correlation of 0.54 between ESG ratings from major providers. This figure contrasts with the 0.92 correlation between credit ratings from Moody's and Standard & Poor's. The divergence reflects methodological differences in scope (what factors are covered), measurement (how they are quantified), and weighting (how factors are aggregated into composite scores). Its practical consequence is that ESG grounded investment and management decisions embed significant, frequently unacknowledged measurement uncertainty. However, recent developments in sustainability reporting standards showcase progress, with the ISSB standard and ESRS potentially improving disclosure consistency and comparability over time.

Greenwashing is the second. Its forms are varied and often sophisticated. Net-zero commitments unsupported by credible transition pathways, ESG fund labels applied to portfolios with negligible sustainability differentiation and environmental certifications that capture narrow metrics while ignoring broader impacts. What greenwashing shares across its manifestations is a strategic exploitation of information asymmetry between disclosers and audiences, corroding the institutional trust that the entire ESG enterprise depends on. Regulatory responses are still expanding, as reflected in initiatives such as the EU Green Claims Directive, the UK FCA's Sustainable Disclosure Requirements, the SEC's climate disclosure rules. At the same time, enforcement frameworks are still evolving, and the interaction between regulatory design and corporate compliance practices remains dynamic.

The third challenge, and perhaps the most structurally intractable, is the time-horizon mismatch. Genuine ESG transformation, such as decarbonising an energy system, rebuilding supply chains around human rights standards, closing persistent gender pay gaps or developing board diversity at industry scale – requires multi-decades commitment and investment. The institutional architecture of capital markets, however – quarterly earnings reports, fund manager tenures, benchmarking against short-horizon equity indices – creates systematic and powerful pressure against the long-horizon thinking that sustainability transformation demands. This is not a problem of intentions – it is a structural misalignment between the temporal logic of ecological and social change and the temporal logic of contemporary financial markets. Resolving it requires institutional innovation in fiduciary duty frameworks, executive incentive design and benchmarking conventions.

5. Conclusions

ESG integration has arrived at a peculiar moment: widely adopted in language, unevenly implemented in practice, periodically under-specified relative to its practical ambition. This paper has attempted to address the theoretical deficit by tracing ESG integration's intellectual foundations across stakeholder theory, institutional economics, and strategic management; by articulating a multidimensional framework that distinguishes the strategic, operational and reporting dimensions of adoption and by systematically examining the value creation mechanisms and structural challenges that determine whether integration is genuine or performative.

Three conclusions follow. First, ESG integration cannot be adequately understood through a single theoretical lens. Its analytical depth emerges from the convergence of stakeholder theory, institutional theory, and the resource-based view – each contributing a dimension that the others alone cannot provide. Strategic purpose, operational practice and transparent reporting must cohere. Where they do not, ESG remains the surface phenomenon vulnerable to the pressures it nominally addresses. Second, the value creation case is real, multi-channelled, and strongest over long time horizons – but not automatic. It depends critically on integration depth. Enterprises that treat ESG as primarily a disclosure exercise will generate disclosure. Those that embed ESG into purpose, strategy, operations, and accountability systems will generate value in the long term.

Third, the structural challenges – rating divergence, greenwashing, and the time-horizon mismatch – are genuine and not fully resolved by existing regulatory or market mechanisms. Acknowledging them is not a counsel of pessimism but a condition of analytical integrity. The concept that deserves particular emphasis is the double materiality, which the CSRD has moved from academic discussion to legal obligation by requiring firms to account for their impact on the world, and not merely the world's impact on their financial position. It enacts a pluralistic conception of corporate accountability that stakeholder theory has long advocated. Whether mandatory disclosure translates into substantive behavioural change or produces a sophisticated compliance industry is an empirical question of considerable urgency for future research. Two directions seem most pressing: longitudinal studies tracking integration depth, as distinct from disclosure volume, against enterprise outcomes, and comparative institutional analysis examining how different regulatory materiality frameworks shape the quality and durability of ESG adoption across governance contexts.

The question that underlines this entire inquiry – whether modern business models can be durably restructured around environmental stewardship, social responsibility, and accountable governance – remains genuinely open. The conceptual foundations examined here suggest it is possible. Whether that possibility is realized depends on choices by managers, investors, regulators, and scholars that are still, consequentially, being made.

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VOICE SEARCH AS A SUSTAINABLE DIGITAL INNOVATION: TRANSFORMING CUSTOMER INTERACTION AND BUSINESS RESILIENCE

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Abstract: Digital transformation together with artificial intelligence creates new methods which organizations use to connect with their customers while developing their services and maintaining their competitive edge in rapidly changing market conditions. Voice search has developed into a fast-paced digital technology which enables users to find information and access services through their natural way of speaking. The existing research base on voice search technology shows three areas of study which include technological aspects and user adoption and customer engagement methods. The research treats voice search as an interactive tool which companies use to understand organizational development through digital innovation for sustainable business growth and business resilience. The research gap gets addressed through a literature review which examines 22 academic studies that focus on voice search and conversational artificial intelligence and digital transformation and sustainability and business resilience. The analysis uses three main themes which include technology adoption and AI-based interaction and digital marketing evolution and environmentally friendly digital innovation and organizational resilience. Voice search systems change how customers interact with brands because they provide users with an easier way to talk with systems which improves their digital access to information while they also affect how companies conduct their marketing efforts and create new services and react to market changes. The added value of this review lies in its integration of three research streams that are often treated separately: voice search and customer interaction digital sustainability and business resilience, into a unified conceptual framework. The study shows voice search functions as a sustainable digital innovation because it serves as an advanced search system rather than a basic search interface.

Keywords: Voice search; artificial intelligence; digital transformation; customer interaction; digital sustainability; business resilience.

Classification JEL: O33, M31, L86, O35, M15.

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1. Introduction

1.1 Digital Transformation and the Rise of Artificial Intelligence

Enterprises undergo digital transformation as their primary method for driving organizational changes in present-day economic systems. The implementation of artificial intelligence systems together with big data analytics and cloud computing and Internet of Things technologies has become a widespread practice among businesses in every sector for achieving better operational results and making superior decisions and creating new product offerings (Hokmabadi et al., 2024). Digital transformation functions as a complete organizational transformation that changes all business activities from their core operations to their digital.

Organizations use artificial intelligence technology to handle extensive data streams which enable them to automate intricate processes while delivering services through their intelligent systems (Ojika et al, 2021). The implementation of AI-driven technologies has become standard practice in customer-facing applications and digital platforms and service infrastructures, which enables companies to develop digital experiences that enhance customer satisfaction through tailored and quick responses.

The latest advancements in conversational artificial intelligence have changed how users interact with digital systems. Digital platforms now enable users to communicate through natural language which creates optimal human-computer interaction methods that replace traditional graphical interfaces (George, 2025). The new digital interaction environments which emerge from these developments use conversational interfaces to connect users with different digital services.

Digital technologies enable organizations to operate more efficiently, and they also enhance organizations' ability to adapt to changing circumstances.

1.2 Emergence of Voice Search in the Digital Ecosystem

Voice search has become a quickly developing digital transformation technology which provides people with new ways to interact with their digital devices. Users can use voice search to find information and access online services and complete their tasks by speaking instead of typing. The system depends on AI progress which includes natural language processing and speech recognition technologies that allow platforms to understand spoken commands and create suitable responses (Zierau et al., 2023).

People now use voice-enabled technologies more frequently which has led to voice search becoming a standard part of their online activities. Voice assistants in smartphones and smart speakers and connected devices let users control digital systems through natural conversational methods (Myers et al. 2018). Voice-based interaction allows users to express their needs through spoken language which makes digital processes easier than traditional search interfaces that require users to stop and type their needs or use menus.

People now prefer to use voice search instead of typing. Users currently view conversational AI systems as universal machine control centers which process user demands through natural language to connect users with digital solutions. Voice interfaces function as access points to digital ecosystems which allow users to connect with multiple services through a single voice-enabled system (George, 2025).

Voice technologies come with various technological problems and usability issues which need to be addressed before their benefits can be utilized. The system struggles to understand spoken language because different people use their native language.

1.3 Transformation of Customer Interaction

The introduction of voice technologies has transformed the way customers engage with digital systems and organizations. Users of digital systems must use graphical interfaces and text-based queries to search through search engines and websites and applications because traditional digital systems require this method of operation. People can now use voice interfaces to talk with systems in a way that feels more like natural human dialogue.

Research shows that voice-based systems improve customer service because they create interactive experiences which customers find easy to use. Zierau et al. (2023) show that voice interfaces create service experiences which customers find enjoyable and which improve their service evaluation and actual behavior. Customers can search for products and request services and get information through voice technologies which work better than conventional typing methods (Gupta & Mukherjee, 2024).

The way people interact with others leads to changes in their decision-making patterns. Voice assistants serve as digital service pathfinders who assist users to navigate service

environments while offering product recommendations and purchasing support (Mari & Algesheimer, 2021). Voice technologies now transform customer experiences through online platforms while they create new ways for customers to interact with business brands.

People who want to use voice interfaces will face obstacles because of their worries about privacy and risk and their doubts about technology functioning correctly. Users may hesitate to interact with voice assistants because they fear that their voice data will be collected and their personal information will be disclosed (Gupta & Mukherjee, 2024). Trust and data governance and technological accuracy require resolution because these issues develop into fundamental requirements for encouraging long-term adoption of voice-based technologies.

1.4 Research Gap and Study Objective

Researchers have studied voice technologies and digital interaction systems but most existing academic work which deals with these topics focuses on either technological progress or user adoption or customer engagement. Researchers investigate how voice interfaces create usability problems (Myers et al., 2018) and study how voice technologies impact customer experiences in online shopping environments (Gupta & Mukherjee, 2024).

Digital transformation and technological innovation research show how these two elements help organizations build better organizational resilience and sustainability. Organizations that implement digital technologies gain better capabilities to handle environmental changes which enable them to sustain their competitive advantage during market changes (Hokmabadi et al., 2024; Nosike et al., 2024).

The current research field lacks studies which show how voice search systems link customer engagement with three essential organizational processes which make up digital innovation and sustainability and organizational resilience. Organizations need to comprehend voice search technology because it functions as a vital digital innovation element of modern business environments.

The study will examine how voice search systems serve as digital technological advancements which change the way customers interact with businesses while helping organizations achieve resilience and sustainable digital growth.

The study will investigate the research questions which follow this main objective.

RQ1: How does voice search technology transform customer interaction in digital environments?

RQ2: What role does voice search play in digital innovation within contemporary business ecosystems?

RQ3: How can voice search technologies contribute to organizational resilience and sustainable business development?

2. Literature Review

2.1 Technology Adoption and the Technology Acceptance Model (TAM)

The primary focus of research in information systems and marketing studies centers on understanding why people begin to use different technological innovations. The Technology Acceptance Model (TAM) serves as the most used theoretical model that explains how people adopt new technologies. Users will accept a technology according to TAM because they develop

two main judgments about the system which includes perceived usefulness and perceived ease of use. The Technology Acceptance Model started as a framework to analyze organizational information systems, but researchers have since applied it to various new digital technologies such as artificial intelligence systems and digital platforms and conversational interfaces. TAM functions as an effective model to assess how users make decisions about adopting voice search technologies because it shows how users assess these systems.

The research studies about vocal technologies demonstrate the existence of TAM elements through their observations. Users often view voice interfaces as effective and user-friendly options for gathering information and performing online tasks. Voice interfaces enable customers to search for products and contact businesses through voice commands which leads to improved customer engagement during online shopping according to research findings (Gupta & Mukherjee, 2024). Customers who believe that voice technologies act as useful digital helpers will start using these technologies.

The process of how users interact with voice technologies determines their attitudes about those systems. Voice-based service interactions create immersive experiences which enhance customer satisfaction together with their behavioral results. When users find voice interfaces to be easy for operation, they will use them more frequently which shows that perceived ease of use matters for using conversational technologies (Zierau et al., 2023).

User acceptance of voice technologies depends on the barriers which different users face. Privacy concerns together with perceived risks and technological limitations create obstacles which prevent people from adopting new technologies. Users need voice assistants only if they believe their data will remain private and the speech recognition systems will work reliably (Gupta & Mukherjee, 2024; Myers et al., 2018). The adoption of voice-based interaction systems depends on trust together with the technological reliability which users need to interact with these systems.

2.2 Voice Search Technology and AI-Driven Interaction

The voice search technology development process establishes a significant technological improvement for digital interaction systems that operate using artificial intelligence. The system employs artificial intelligence technology through its speech recognition and natural language processing (NLP) and machine learning components which enable the system to interpret spoken commands and deliver suitable answers (Zierau et al., 2023).

Users can speak to operate voice technologies which deliver a more intuitive way to communicate than current text-based search methods. Users can use voice interfaces to interact with digital systems by speaking natural language which makes it easier to navigate digital content while improving accessibility for all users.

The conversational interaction system enables users to obtain information and services through mobile and smart devices in a more efficient manner. Businesses today implement conversational AI systems to control their online digital environments. The users in conversational computing environments can control multiple digital services through a single natural-language interface according to George (2025). Voice technologies function as system intermediaries because they interpret user requests to deliver access to specific digital services. The advantages of voice interaction come with multiple technological obstacles which need to be addressed.

The speech recognition systems fail to interpret spoken commands because people pronounce words differently from one another and they use different accents and sentence structures (Myers et al. 2018). The technological limitations create obstacles for users to communicate which results in decreased confidence with voice-based systems.

2.3 Adoption of Voice Search Technologies

The use of voice search technologies depends on three different types of factors which are technological factors, psychological factors, and experiential factors. The main element which people consider when assessing a system is its ability to support interactions between users and the system. Voice interfaces provide users with a faster way to accomplish digital tasks because they eliminate both the need for typing and the need for complex interface navigation.

The research which investigates voice interaction in digital commerce shows that voice interfaces make product discovery and data extraction simpler which leads to better customer interaction during online shopping (Gupta & Mukherjee, 2024). The process of adopting recent technology depends heavily on people's actual experiences with technology. Zierau et al. (2023) demonstrate that voice-based service interactions can create flow-like experiences that enhance consumer satisfaction and improve behavioral outcomes. People who use immersive interaction experiences will continue to use voice technologies more because these experiences build their connection with technology.

Voice technologies face multiple obstacles which prevent people from using these systems. People will become less willing to use voice-based systems because of three main factors which include their concerns about privacy and their perception of risk and their doubts about the technology's reliability (Gupta & Mukherjee, 2024). Users face problems when they try to use voice interfaces because speech recognition systems do not understand their spoken commands (Myers et al., 2018).

Table 2: Summary of Key Studies on Voice Search Technologies

Author(s)	Research Focus	Key Findings	Relevance to This Study
Zierau et al. (2023)	Voice-based service interfaces	Voice interactions create immersive service experiences	Demonstrates impact on customer interaction
Gupta & Mukherjee (2024)	Voice interfaces in e-retail	Convenience and satisfaction drive customer engagement	Highlights role in digital commerce
Myers et al. (2018)	Voice user interface usability	Users face challenges with speech recognition errors	Shows technological barriers
Klaus & Zaichkowsky (2020)	AI voice bots in services marketing	AI assistants influence consumer decision processes	Indicates marketing transformation
Ranuga et al. (2025)	Voice search optimization	Voice SEO improves visibility and engagement	Shows strategic marketing implications
Costa et al. (2025)	AI and sustainable innovation	AI contributes to sustainable development and innovation	Links digital technologies with sustainability

Source: Author's elaboration based on Zierau et al. (2023), Gupta and Mukherjee (2024), Myers et al. (2018), Klaus and Zaichkowsky (2020), Ranuga et al. (2025), and Costa et al. (2025).

2.4 Voice Assistants and Consumer Decision-Making

The use of voice assistants has grown because they help users make choices between different digital platforms. Voice systems enable users to find information through digital channels while they compare different options and finish their online purchases by using natural language dialogue. Voice technologies enable customers to find product information through their voice commands which leads to improved search efficiency and better shopping results (Gupta & Mukherjee, 2024). Voice assistants enable users to obtain product details and service recommendations through their voice commands which enhances shopping efficiency and convenience (Gupta & Mukherjee, 2024).

Voice assistants provide personalized product suggestions which help customers make purchasing choices. AI-powered systems analyze user preferences, browsing history, and contextual data to generate tailored suggestions, which help users make choices between online products (Mari & Algesheimer 2021).

Voice-based decision-making includes specific limitations which need to be understood. Voice assistants provide users with fewer choices than visible options available in graphical user interfaces. Businesses need to enhance their online material and search presence because they want to maintain service accessibility through voice search systems.

2.5 Voice Search and Digital Marketing Transformation

Marketers are changing their digital marketing methods because voice technology has become more common on digital platforms. Voice search transforms user information access and brand interaction and online platform usage.

People who conduct voice searches use longer and friendlier dialogue to build their search queries which they express through questions and natural speech patterns. Businesses need to change their digital marketing approaches because people now use search engines to find information. Businesses need to create their online content to match the way people talk and the way they search using natural language.

Voice search optimization therefore uses conversational keywords and structured data and context-aware search results to achieve digital visibility because these elements run (Ranuga et al., 2025). Voice technologies also influence how organizations engage with consumers during the purchasing process.

Users can search for products and request services and complete transactions through spoken commands by using voice interfaces which provide conversational interactions. Research findings demonstrate that voice interfaces make product discovery easier and they boost user engagement in digital commerce environments (Gupta & Mukherjee, 2024).

Voice technologies can create marketing interactions which better match individual customer needs. AI-powered voice assistants use their ability to analyze user preferences together with contextual information to deliver personalized product recommendations and service recommendations. Companies use this capability to develop customer experiences which better address individual customer needs thus building stronger customer relationships together with better marketing results (Mari & Algesheimer, 2021).

Organizations face operational difficulties because of voice search technology. Voice assistants create intense competition in voice search environments because they show users only a few recommended search results. Organizations need to optimize their

digital content and search strategies because they want to stay competitive in voice-enabled digital environments.

2.6 Artificial Intelligence and Sustainable Business Innovation

Artificial intelligence functions as the primary force that drives organizations toward digital progress and their efforts to achieve sustainable business changes. Organizations use AI technologies to handle extensive data sets which they need for their automated operations and their improved decision-making abilities to boost their work efficiency and their capacity to create new ideas.

Research shows that AI-powered digital transformation technologies help organizations become more adaptable while using their resources more effectively in various industries. AI technologies enable businesses to enhance their data management systems which leads to better operational performance and results in useful business information that supports their strategic planning process (Ojika et al., 2021). The application of AI-driven technologies creates economic sustainability as they enable organizations to boost their productivity and build superior digital service delivery systems (Svergun et al., 2025).

Academic studies have started to investigate the connection between digital innovation and sustainability. George et al. (2021) introduced digital sustainability which describes how organizations use digital tools to achieve their sustainable development objectives. Digital innovations create socio-economic benefits and environmental advantages according to this perspective which states that responsible resource management and sustainable business operations generate these outcomes.

AI-powered voice technologies function as one of several AI-based digital tools which enhance user access to digital services while creating better operational outcomes. Voice technologies empower users to control digital systems using their natural language which enables users to access information and services through digital systems with less effort.

2.7 Digital Sustainability and Responsible Innovation

The sustainable development benefits of digital technologies require their execution to resolve ethical and environmental and governance issues. Responsible innovation demands that technological development must adhere to social values and ethical standards and sustainability goals.

Digital sustainability research demonstrates that digital technologies produce two types of sustainability results which include positive and negative outcomes. AI technologies make resource usage more efficient while they enable environmental monitoring and better decision-making across various industries (Costa et al., 2025).

AI systems present environmental risks because they require substantial computational power and they process extensive data sets. The implementation and management of AI technologies require organizations to establish proper procedures which enable them to assess different aspects of these technologies. Responsible innovation frameworks require organizations to establish three fundamental components which include transparent operations and data privacy safeguards and ethical governance processes to develop digital technologies that support sustainable development.

Organizations that use voice technologies must address essential issues about privacy protection and data management. Organizations must establish proper data protection

protocols to secure user trust and meet regulatory requirements because voice assistants operate through ongoing voice data collection and analysis (Gupta & Mukherjee, 2024).

2.8 Voice Search as a Strategic Innovation for Business Resilience

Voice technologies transform customer interaction and digital marketing while also enhancing organizational resilience. Business resilience refers to the ability of organizations to adapt to environmental disruptions, respond to market changes, and maintain long-term competitiveness.

Digital transformation research shows that organizations which use advanced digital technologies are better able to manage uncertain situations. Technological innovation enables firms to improve operational flexibility, enhance decision-making capabilities, and respond more effectively to evolving customer expectations (Hokmabadi et al., 2024).

Technological innovation serves as a crucial element that organizations need to ensure their business operations continue during times of crisis according to research about how organizations adjust to unexpected changes. Companies that implemented digital solutions during times of disruption achieved higher success in maintaining their services and resolving operational problems (Nosike et al., 2024).

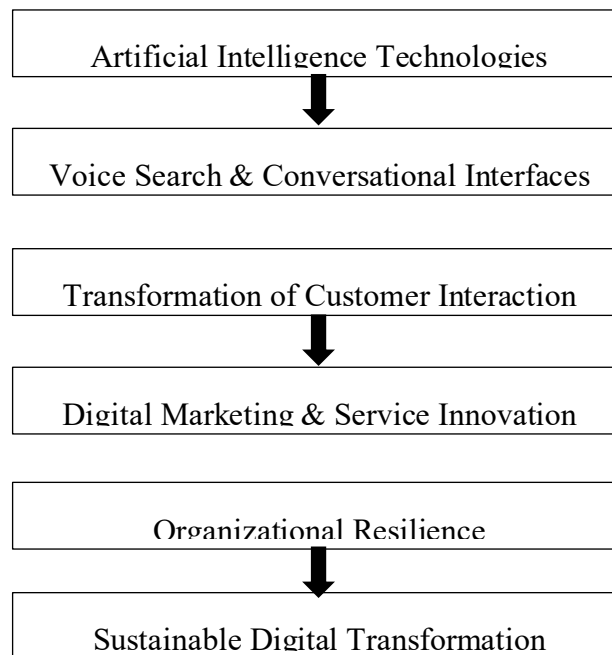


Figure 1. Conceptual Framework of Voice Search, Digital Innovation, and Business Resilience

Source: Author's elaboration based on Gupta and Mukherjee (2024), Zierau et al. (2023), George et al. (2021), Hokmabadi et al. (2024), and Nosike et al. (2024).

Organizations use voice technologies to build digital service systems which operate at higher levels of efficiency. Voice interfaces provide firms with additional channels for interacting with customers and delivering digital services in real time. Voice technologies enable organizations to strengthen customer relationships through efficient communication and better service access which leads to improved organizational adaptability in digital environments that experience fast changes.

This Conceptual framework illustrating the role of voice search technologies in transforming customer interaction and supporting digital innovation and business resilience.

3. Methodology

3.1 Research Design

This study adopts a qualitative literature review to examine existing academic studies about voice search technology and artificial intelligence and digital innovation and organizational resilience. The literature review method enables researchers to combine different research fields while showing how new technologies are developing through their existing conceptual frameworks.

Academic research has been conducted across multiple fields which include information systems and digital marketing and human-computer interaction and innovation management to study the quick advancements of voice technology.

A literature review therefore provides an appropriate methodological approach for integrating findings from these different research domains and developing a comprehensive understanding of how voice search technologies influence customer interaction and business innovation.

Researchers have employed the same review methods to study how digital transformation affects business resilience. The researchers conducted a systematic review which investigates how digital transformation impacts organizational resilience in small and medium-sized enterprises (Hokmabadi et al., 2024). The research conducted by Nosike et al. (2024) demonstrates that technological innovation and adaptive strategies serve as essential elements for organizations to strengthen their capacity to address environmental challenges.

The present study develops its research by combining existing studies about voice search technologies and conversational AI systems and digital marketing transformation and sustainable digital innovation.

3.2 Data Sources

The literature analyzed in this study was collected from major academic databases which researchers use in management marketing and information systems studies. The databases provide access to peer-reviewed journal articles and conference papers and academic publications which cover digital technologies and business innovation. The selected studies cover several research areas which are relevant to the objectives of this study.

The research areas include the following:

- voice search technologies and conversational AI;
- voice user interfaces and human–computer interaction;
- digital transformation and AI-driven innovation;
- digital marketing and customer interaction;
- organizational resilience and technological adaptation.

Research on voice-based interaction systems investigates usability problems which users experience with voice user interfaces (Myers et al., 2018). Studies on digital commerce environments examine how customers respond to voice interfaces which affect their

purchasing decisions (Gupta and Mukherjee, 2024; Zierau et al., 2023). Research investigates how organizations use digital transformation and technological innovation to build their resilience and sustainability capabilities (Hokmabadi et al., 2024; George et al., 2021; Costa et al., 2025).

3.3 Selection Criteria

This research applied multiple selection criteria to maintain both the current relevance and the high quality of literature which was wanted to be included in the review. The selected studies needed to investigate voice technologies or artificial intelligence or digital interaction systems or business digital transformation.

The research showed how voice interfaces function in marketing and e-commerce and service environments which helps understand their impact on customer interaction. Digital technology research studies are needed to explore strategic digital technology effects while examining digital innovation and sustainable development and organizational resilience research. The selected publications needed to present either empirical research or conceptual frameworks which describe digital interaction systems and AI technologies and business innovation.

Using these criteria, twenty-two relevant academic studies were selected and analyzed in this literature review.

3.4 Analytical Approach

The chosen research studies underwent analysis through thematic analysis, which serves as a standard method for literature reviews to detect recurring themes that exist in previous studies.

The analysis identified five main themes which served as the central focus of the study.

- The first theme of the study examined voice technologies and AI-driven interaction systems.
- The second theme of the study examined customer engagement and digital customer experiences.
- The third theme of the study examined digital marketing transformation and voice search adoption.
- The fourth theme of the study examined digital innovation and sustainable business development.
- The fifth theme of the study examined organizational resilience and technological adaptation.

The research study used these themes to create the literature review which assisted in understanding the results that appeared in the results and discussion sections.

4. Results and Discussion

4.1 Emerging Trends in Voice Search Research

The examined studies demonstrate that voice search technology research has progressed from studying specific technological aspects to investigating its application across multiple

fields which include digital marketing and customer experience and sustainability and organizational resilience.

The first study in this field investigated how users interact with voice user interfaces through their usability difficulties and voice user interaction patterns. The researchers Myers et al. (2018) studied user interactions with voice interfaces to find multiple problems which stemmed from speech recognition failures and system performance restrictions.

The current research investigates how voice technologies affect digital ecosystems beyond their technological usability characteristics. Users now prefer conversational AI systems because these systems enable them to use natural language when they interact with digital platforms instead of relying on conventional application interfaces (George, 2025).

This shift suggests that voice technologies are becoming central access points for digital services. A second area of development in relation to consumer experience is the increasing influence that voice technology has had on changing the way consumers experience interactions with products/services. Studies have shown that consumers who use voice interfaces have a more intuitive and natural way of interacting with a service compared to consumers who do not utilize voice interfaces; as a result, there are increased levels of engagement and consumer satisfaction (Zierau et al., 2023). Furthermore, voice-tied digital marketplaces allow consumers to find products/services (through voice commands) in much more convenient and efficient ways (Gupta & Mukherjee, 2024).

In addition, scholars are beginning to examine how organizations can leverage voice technologies to create their digital marketing strategies. Companies are increasingly examining how they might leverage voice search optimization and conversational interfaces as part of their digital marketing strategy both of which are essential components for shaping the way the organization structures content and communicates with their consumer base across all digital channels (Ranuga et al. 2025).

Table 3: Key Research Themes Identified in the Literature

Theme	Description	Key References
AI-driven voice interaction	Voice technologies enable natural language interaction between users and digital systems	Zierau et al. (2023); George (2025)
Customer engagement and experience	Voice interfaces improve convenience and user engagement in digital services	Gupta & Mukherjee (2024)
Digital marketing transformation	Voice search changes search behavior and requires new content optimization strategies	Mari & Algesheimer (2021); Ranuga et al. (2025)
Sustainable digital innovation	AI technologies contribute to sustainable development and innovation	George et al. (2021); Costa et al. (2025)
Organizational resilience	Digital technologies help firms adapt to disruptions and changing markets	Hokmabadi et al. (2024); Nosike et al. (2024)

Source: Author's elaboration based on the reviewed academic literature.

4.2 Impact of Voice Search on Customer Interaction

Voice search technologies create a new way for users to engage with online platforms. Users can connect with digital systems through voice search which removes the need for users to use traditional methods that combine graphical interfaces with typed inputs. Users can use voice interfaces to obtain information and complete tasks through digital systems with less need for cognitive and physical effort because the system simplifies their tasks.

Research shows that when customers use voice-based services they experience deep interactive moments which create a good impression of the service and help achieve business results (Zierau et al., 2023). The use of voice interfaces helps customers to find products and obtain information at a quicker speed which enhances their online shopping experience. People can use digital systems through natural language queries which enhance their ability to access these systems (Gupta & Mukherjee, 2024).

Digital interaction improvements will lead to more customer engagement while creating stronger bonds between customers and businesses. The success of voice-based interaction systems depends on both the technological system and the user's confidence in the technology. Consumers will find it harder to use voice interfaces when speech recognition systems fail because they will not understand the speech and this will make them less likely to trust voice services (Myers et al., 2018).

The development and long-term success of voice technologies require organizations to create solutions which solve existing technological constraints.

4.3 Strategic Implications for Businesses

Organizations achieve essential business benefits through their adoption of voice technology on their online platforms. Voice interfaces enable companies to engage with customers through spoken dialogues which allow them to provide customized digital solutions that adapt to user needs.

Voice technologies also impact digital marketing methods that businesses use. Businesses require new search optimization techniques because their existing methods fail to handle voice search queries which use natural speech patterns that include questions and conversational speech.

Voice search optimization serves as a critical component for businesses to establish their online presence (Ranuga et al., 2025). The advancement of voice technologies will create advantages for digital service delivery systems. Customers can use AI-powered voice assistants to explore products and receive tailored advice which helps them choose the right products. Through these capabilities organizations can develop digital service platforms that enhance user engagement while boosting operational efficiency (Mari & Algesheimer, 2021).

The adoption of voice technologies introduces various obstacles which organizations must work to solve. Privacy concerns and technological reliability and user trust issues continue to shape how people accept voice-based systems. Organizations need to establish secure data management systems and trustworthy voice technology solutions for their users to have successful experiences.

4.4 Voice Search and Sustainable Digital Innovation

The use of voice search technologies enables sustainable digital innovation because it helps organizations to operate better and makes digital content more accessible to users who need it. Organizations use AI-driven systems to handle their standard tasks which help them to manage their resources more effectively and make better decisions (Ojika et al., 2021). The concept of digital sustainability suggests that digital technologies can support sustainable development when they create both economic and societal value.

George et al. (2021) demonstrate that digital innovation helps organizations achieve sustainability because it enables them to provide better services while using fewer resources. Voice technologies can support this process by enabling more efficient digital communication between users and organizations.

Voice-enabled systems allow companies to handle customer service tasks automatically which reduces their requirement for human support. The better service delivery, which results from these changes will lead to businesses achieving sustainable operational results.

Responsible innovation practices should be established because they help organizations develop digital technologies in an ethical and sustainable way. The studies about AI and sustainability demonstrate that digital technologies need proper governance to handle issues which involve energy usage and data protection and ethical practices (Costa et al., 2025).

4.5 Voice Search and Organizational Resilience

The implementation of voice search technologies will enhance organizational resilience because these technologies enable companies to better adjust to market fluctuations. Organizations that adopt innovative digital technologies are often better positioned to respond to disruptions and maintain competitiveness in uncertain environments.

Research about digital transformation shows that technological innovation enables organizations to develop both flexibility and adaptability to changing situations. The implementation of digital technologies by companies enables them to deliver better services while creating stronger customer relationships which help them meet changing consumer demands (Hokmabadi et al., 2024). Voice technologies enable organizations to establish extra communication pathways which customers can use to reach them. Voice interfaces enable businesses to deliver services more efficiently while establishing real-time connections with their customers which makes it easier for companies to build customer bonds and operate their businesses during fast-changing digital markets.

The research about crisis management indicates that organizations which implement digital technologies will experience greater resilience during times of disruptive events. The companies that adopted digital technologies during the worldwide health crisis experienced improved operational capacity and market adaptation abilities (Nosike et al., 2024).

5. Conclusion

5.1 Summary of Key Findings

The research investigated how voice search technologies serve as a new digital technology which changes how customers engage with businesses while helping companies maintain their operational stability during the ongoing process of digital transformation. The literature review

demonstrates how voice technologies have become an essential element in modern digital systems based on the review of twenty-two academic studies. The research results demonstrate that voice search technologies create a new method for humans to interact with computers because they enable users to speak with digital systems through conversational dialogue.

Users of voice-based systems can use their natural speech to navigate digital platforms whereas traditional interfaces require them to input text and use visual elements for navigation. Conversational engagement in digital systems makes them more accessible to users and provides them with easier access to information, leading to an overall better digital customer experience (Zierau et al., 2023; Gupta & Mukherjee, 2024).

Prior literature has shown the relationship between voice technologies and how they affect customer engagement and how they affect service delivery experiences. Voice interfaces establish user-friendly virtual environments which enhance customer satisfaction while increasing their likelihood of making purchases. Voice technologies simplify digital tasks which include product discovery and service availability thus enabling users to use digital systems with greater ease.

Another important finding shows how voice technologies function strategically within digital marketing and business innovation. Users can now access services and information through digital platforms which use conversational AI systems as their new interaction channels that operate through natural language communication (George, 2025). Businesses need to change their digital marketing methods and content designs because customers now use conversational search to find information.

The research shows that voice technologies enable organizations to achieve sustainable digital innovation and build their organizational resilience. Companies use artificial intelligence technologies to improve their data analysis capabilities and process automation abilities which leads to better operational performance (Ojika et al., 2021).

Organizations that implement digital technologies which are ahead of their time gain better abilities to deal with market disruptions while staying competitive in rapidly changing business environments (Hokmabadi et al., 2024; Nosike et al., 2024).

Voice search technologies function as a crucial element of digital transformation because they enhance customer interactions and drive innovation while helping businesses in modern environments to build resilience.

5.2 Theoretical Contributions

The research expands the number of ways in which the current literature is being developed further by acting on multiple areas of academia. Through integrating research from multiple academic disciplines: voice technologies; digital marketing; artificial intelligence; sustainability; organizational resilience; the study can provide a more comprehensive understanding of the strategic impacts of voice search technologies to the organizations that employ them.

The research also investigates voice technologies in a novel way by examining their effect on organizational performance and user acceptance, expanding on current body of knowledge. Additionally, the study highlights how voice technologies provide value to businesses by both creating new products as well as enabling organizations to execute their digital transformation initiatives.

The research examines voice-based interaction systems as a bridge between artificial intelligence and studies of sustainable development providing a connection to the area of digital sustainability research, where digital services are accessible and create efficiencies through sustainable digital innovations.

The study uses the Technology Acceptance Model framework from the literature review to give researchers a theoretical method for studying consumer usage of voice-based services. The study develops a complete theoretical model that assesses voice technologies in digital ecosystems by combining technology adoption theories with digital innovation and sustainability theories.

5.3 Managerial Implications

The study results demonstrate multiple practical applications which managers and organizations can use to implement voice technologies within their digital operations:

- First, businesses should recognize voice search as an increasingly important channel for customer interaction. Organizations need to make their digital platforms ready for voice-based communication because voice-enabled devices and conversational interfaces have gained popularity in the current market. Organizations need to make their digital content ready for voice searching and they need to implement voice search optimization methods.
- Second, organizations should incorporate voice technologies into broader customer experience strategies. Voice interfaces enable customers to access services easier while customers can interact with digital platforms more easily. The use of voice technologies in digital service environments enables businesses to develop customer experiences which deliver personalized and effective service.
- Third, companies should consider the role of voice technologies in supporting sustainable digital innovation. The AI-driven voice systems enable organizations to automate service interactions which results in lower operational expenses and enhanced digital process efficiency. Technology enables businesses to achieve their sustainability targets while enhancing their operational performance when implemented responsibly.

The organizations need to solve three main issues which include technological reliability problems together with privacy protection challenges and user trust difficulties. The effectiveness of voice technologies relies on two main components which include precise speech recognition systems and clear data handling methods. Organizations that choose to secure their systems through secure technologies while maintaining responsible governance will gain user trust which will enable them to achieve sustained user adoption.

5.4 Future Research Directions

The literature review demonstrates how voice search technologies support digital transformation yet needs additional research for several unexplored areas.

The first research area needs to assess how voice technologies affect both organizational performance and business resilience through actual measurements. Existing studies demonstrate potential advantages of voice technologies yet require additional research to assess their actual impacts on business outcomes.

Future studies should investigate how different industries adopt voice technology across various sectors of their operations. Voice search technologies create different effects across various sectors which include retail and healthcare and finance and hospitality. Businesses across different industries employ voice technologies in distinct ways which comparative research can reveal through its analysis of different industry contexts. Research needs to investigate how voice technologies connect with sustainable digital innovation efforts.

Current research shows digital technologies can help achieve sustainability goals, yet researchers need to determine how voice systems enable better environmental performance and sustainable resource use. The research needs to assess how conversational AI and voice technologies create ethical and governance challenges which center on data privacy and algorithmic transparency and responsible AI deployment. The growing use of voice technologies through digital ecosystems will require society to understand their effects on social systems.

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THE SIX CONDITIONS FRAMEWORK AS AN ANALYTICAL TOOL FOR COLLECTIVE IMPACT INITIATIVES IN CHILD CARE SYSTEM REFORM

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Abstract: Reforming a national childcare system is a complex social problem that requires systemic change, as its causes are deeply rooted and the actors involved are highly interdependent. Traditional approaches often address only visible symptoms and are insufficient for creating lasting, transformative results. While the Collective Impact model (Kania & Kramer, 2011) provides a structured approach for multi-sector collaboration through its five key conditions, it requires a deeper analytical lens to examine the full scope of systemic change. To address this challenge, it is suggested to use the Six Conditions for Systems Change framework (Kania, Kramer & Senge, 2018) as a tool to analyze the depth and quality of transformations occurring within a Collective Impact initiative. The framework examines change across three levels: explicit (policies, practices, resources), semi-explicit (relationships, power dynamics), and implicit (mental models). The research analyzes outcome level monitoring data from the child care system strengthening initiative in the Republic of Moldova, which supports the transition from institutional to family-based child care. Data was collected using the Outcome Harvesting methodology, which identifies specific changes, traces the initiative's contribution to them, and validates findings with external sources. Preliminary analysis reveals changes at all three systemic levels. At the explicit level, new national policies and budget allocations for family-type services were documented. At the semi-explicit level, strengthened partnerships between local authorities and NGOs were observed, alongside shifts in decision-making dynamics. At the implicit level, early evidence suggests gradual changes in professional mindsets regarding the role of family care versus institutional placement. The Six Conditions framework provides a practical and holistic tool for evaluating complex social reforms.

Keywords: systems change, six conditions for systems change, Collective Impact, child care reform, Outcome Harvesting, Moldova, deinstitutionalization.

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1. Introduction

Reforming a national child care system is a complex social challenge that requires systemic change, that is, confronting root causes by transforming structures, customs, mindsets, power dynamics, and policies through the active collaboration of diverse actors (Catalyst 2030, n.d.). In post-Soviet countries, including the Republic of Moldova, the legacy of institutionalization has created structures, habits, and mindsets that resist transformation. During the transition period, the region inherited a public attitude and a state approach dominated by institutionalization, where uniform family support schemes, such as social insurance, free education and health, full employment were designed for supposedly uniform family needs, and institutionalization was the default solution for families facing difficulties (UNICEF, 1999).

Traditional interventions that focus only on visible symptoms, such as isolated programmatic activities or short-term service delivery, are rarely sufficient to generate sustainable systemic change. Collective Impact (CI) is the methodology that has gained prominence for structuring such collaboration (Kania & Kramer, 2011). Defined as the commitment of a

group of actors from different sectors to a common agenda for solving a specific social problem, Collective Impact relies on five key conditions: a common agenda, shared measurement systems, mutually reinforcing activities, continuous communication, and dedicated backbone support (Kania & Kramer, 2011). Since it was formally described in 2011, CI has been applied in education, public health, juvenile justice, and child protection, both in North America and increasingly in European contexts (Beerman et al., 2021; NYS Juvenile Justice Advisory Group, n.d.).

However, while Collective Impact provides a vehicle for aligning actors and resources, it does not, on its own, offer a framework for analyzing the change occurring within a system. In complex domains such as child care reform, success depends not only on formal policy shifts but also on transforming relationships, power dynamics, and deeply held beliefs about what constitutes appropriate care for children. This article addresses this gap by integrating the Six Conditions for Systems Change framework (Kania et al., 2018) as an analytical lens for examining Collective Impact initiatives.

The research draws on outcome-level monitoring data from the Changing the Way We Care (CTWWC) initiative in the Republic of Moldova, which supports the transition from institutional to family-based care. Using Outcome Harvesting (Wilson-Grau, 2019; Wakia & Safronova, 2025), the study captures changes in the behavior of key actors, such as government officials, civil society organizations, faith-based groups, and communities, and analyzes them through the three levels of the Six Conditions framework: explicit (policies, practices, resource flows), semi-explicit (relationships, power dynamics), and implicit (mental models).

2. Literature Review

Collective Impact as a Methodology for Multi-Sector Collaboration

The Collective Impact methodology emerged from the recognition that complex social problems cannot be solved by single organizations acting alone. In their seminal article, Kania and Kramer (2011) argued that the fragmentation characteristic of social sector interventions leads to isolated efforts that fail to produce systemic change. Collective Impact was proposed as a structured alternative, bringing together actors from government, civil society, business, and philanthropy around a common agenda for change.

The methodology rests on five key conditions. A common agenda requires that all participants share a vision for change, including a common understanding of the problem and a joint approach to solving it. Shared measurement systems involve collecting data and measuring results consistently across all participants, ensuring that efforts remain aligned and accountability is maintained. Mutually reinforcing activities recognize that effective collaboration does not require all partners to do the same thing; rather, participants engage in differentiated activities coordinated through a mutually reinforcing plan of action. Continuous communication emphasizes that trust cannot be built through occasional meetings; open and consistent communication builds relationships, assures mutual objectives, and creates common motivation. Finally, backbone support acknowledges that effective collaboration requires dedicated infrastructure. This should be a separate organization or structure with dedicated staff that provides ongoing support, managing

logistics, facilitating communication, and ensuring that the collective work remains on track (Kania & Kramer, 2011).

Since its introduction, Collective Impact has been applied across diverse policy domains. In the United States, it has been used to address educational achievement gaps, public health challenges, and juvenile justice reform (NYS Juvenile Justice Advisory Group, n.d.). In Europe, interest has grown steadily, with initiatives emerging in urban security, social cohesion, and child protection (Beerman et al., 2021).

Evolution of the Six Conditions for Systems Change Framework

While Collective Impact provides a methodology for structuring collaboration, it does not offer tools for analyzing the changes produced. This gap led to the development of the Six Conditions for Systems Change framework, which builds on foundational work in systems thinking. The framework's theoretical roots lie in two key sources: Donella Meadows' Iceberg Model and the ABLe Change Framework developed by Foster-Fishman and Watson.

The Iceberg Model, popularized by Donella Meadows (The Donella Meadows Project, n.d.), offers a way of understanding why systems behave as they do. According to this model, events represent the visible tip of the iceberg, e.g. incidents and occurrences that can be easily observed. Below the surface lie patterns of behavior, the trends that emerge over time. Deeper still is system structure, including relationships between different parts of the system that shape how events and patterns unfold. At the deepest level the values, assumptions, and deeply held beliefs that ultimately determine how the system operates. The model illustrates that most factors determining system behavior remain hidden beneath the surface, and identifying these hidden structures is essential for developing durable solutions (The Donella Meadows Project, n.d.).

The ABLe Change Framework, developed by Foster-Fishman and Watson (2012), offers a complementary perspective. The framework distinguishes between components that are "above the line", including the visible elements of social systems, and those that lie "below the line", namely, the operational processes and hidden mechanisms that determine how change initiatives translate into practice. The purpose of the "below the line" component is to ensure that change initiatives are effectively implemented and sustained. The framework emphasizes the interplay between content and process, recognizing that both are essential for systemic transformation.

Building on these foundations, Kania, Kramer, and Senge (2018) proposed the Six Conditions for Systems Change, organizing the insights from systems thinking into an actionable framework. The model identifies six critical conditions that influence systemic transformation, arranged across three levels of visibility. At the structural level, the most visible one, are policies, practices, and resource flows. Policies refer to government, institutional, and organizational rules, regulations, and priorities that guide actions. Practices encompass the activities of institutions, coalitions, networks, and other entities targeted to improving social progress. Resource flows describe how money, people, knowledge, information, and other assets are allocated and distributed. This structure is illustrated in Figure 1.

At the relational level, which is less visible but still accessible, are relationships and connections, and power dynamics. Relationships and connections refer to the quality of connections and communication occurring among actors in the system, especially among those with differing histories and viewpoints. Power dynamics describe the distribution of

decision-making power, authority, and influence among individuals and organizations. Finally, at the deepest, most implicit level, are mental models: the habits of thought, deeply held beliefs, and taken-for-granted ways of operating that influence how we think, what we do, and how we talk.

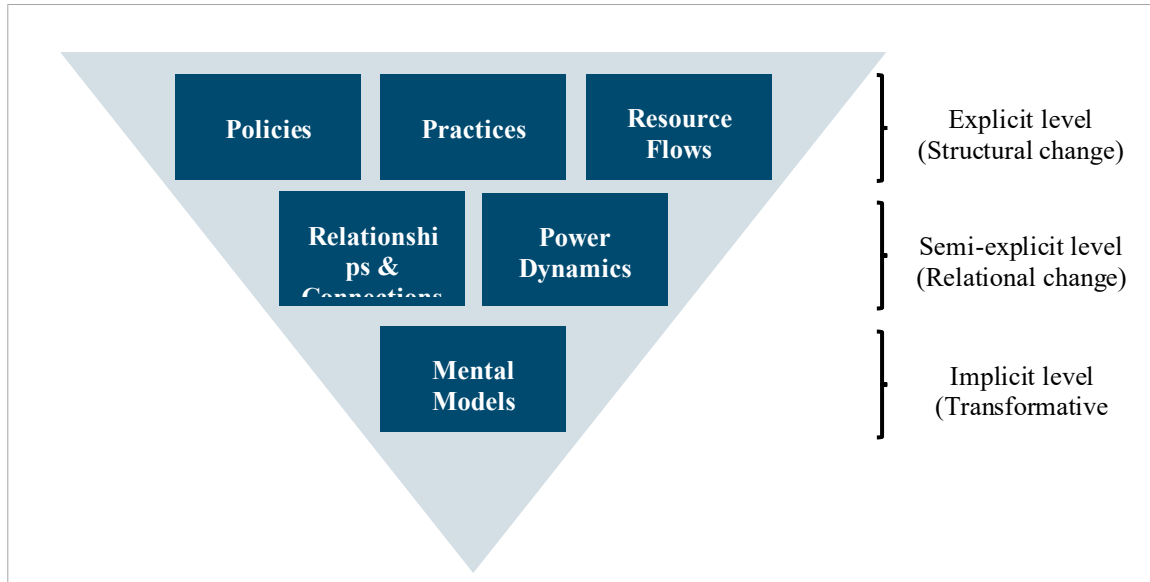


Figure 1. Six Conditions for Systems Change

Source: Kania, J., Kramer, M., & Senge, P. (2018). The water of systems change. FSG.

The framework's key insight is that sustainable systemic transformation requires working across all three levels. Explicit changes, like shifts in policies, practices, and resources, are essential but insufficient on their own. Without attention to relationships, power dynamics, and mental models, shifts in system conditions are unlikely to be sustained.

Understanding Outcomes and Theory of Change in Complex Interventions

To evaluate systemic change initiatives, it is necessary to understand what is meant by an "outcome" and how outcomes relate to broader theories of change. In the field of international development and project management, the logical framework approach and results-based management have provided a vocabulary for thinking about results. The logical framework, initially developed by USAID in 1969 and subsequently adopted by bilateral donors worldwide, organizes interventions into a hierarchy of levels: inputs, activities, outputs, purpose, and goal (World Bank, 2000). Each level is accompanied by indicators, means of verification, and assumptions about external factors (Coleman, 1987).

As results-based management gained prominence in the late 1990s and early 2000s, this vocabulary was refined. The results chain introduced a more detailed set of distinctions: inputs (the resources used for intervention), activities (the actions taken), outputs (the products and services resulting from activities), outcomes (the short- and medium-term effects of outputs), and impact (the longer-term, higher-level effects) (Kusek & Rist, 2004; OECD, 2022). Within this framework, outcomes are understood as changes in the capacities and behaviors of external actors, more precisely - shifts that occur between the completion of activities and the achievement of broader impacts (OECD, 2022).

Outcome Harvesting: A Methodology for Capturing Complex Change

Given the complexity of systemic change initiatives, traditional monitoring approaches that rely on pre-specified indicators are often inadequate. Outcome Harvesting was developed as an alternative methodology specifically designed for contexts where cause-effect relationships are difficult to understand in advance (Wilson-Grau, 2019). The method is retrospective: rather than specifying outcomes in advance and then measuring progress against them, Outcome Harvesting searches for outcomes that have occurred and then works backward to understand how the intervention contributed to them.

The methodology defines an outcome as “*a change in the behavior, relationships, actions, activities, policies, or practices of an individual, group, community, organization, or institution*” (Wilson-Grau, 2019). This definition shifts attention from activities to the changes that matter for a lasting systemic change. The method involves six steps: designing the harvest, formulating outcomes, reviewing outcomes, analyzing and interpreting, substantiating findings, and using the results to inform adaptive management (Wilson-Grau, 2019). Substantiation is a particularly important step, involving external validation of findings by independent individuals knowledgeable about the outcomes. This addresses concerns about bias and ensures that outcomes are not merely claimed but confirmed. Outcome Harvesting has been used across a range of sectors, including human rights, health, education, and child protection. Its value lies in its ability to capture complex, non-linear changes that would be missed by more traditional monitoring approaches.

3. Methodology

The research employed a retrospective monitoring approach based on Outcome Harvesting (Wilson-Grau, 2019), followed by a systematic categorization of the harvested outcomes using the Six Conditions for Systems Change framework (Kania et al., 2018). This design was chosen to capture the multidimensional nature of systemic change within a Collective Impact initiative and to analyze the depth of transformations occurring at different levels of the system. The research focuses on the Changing the Way We Care (CTWWC) initiative in the Republic of Moldova, a global program supporting the transition from institutional to family-based care.

Moldova’s care system is highly government-led, and the initiative has worked since 2021 with national and subnational government actors, civil society, faith-based organizations, and communities. CTWWC adopted a Collective Impact approach, aiming to coordinate diverse actors around a common agenda for care reform (Wakia & Safronova, 2025). The primary data source was the Outcome Harvesting monitoring system implemented by CTWWC. Between 2019 and 2025, the initiative documented 90 outcomes in Moldova, each representing a specific change in the behavior of an external actor. The process followed the six steps of Outcome Harvesting (Wilson-Grau, 2019):

1. Design the harvest: defining the users and key questions.
2. Formulate outcomes: drafting a description of each observed change, its relevance to the initiative’s objectives, the initiative’s contribution, and the source of information.
3. Review outcomes: quality assurance through a collaborative “ping-pong” process.
4. Analyze and interpret categorizing outcomes by actor type, behavior change type, and level of change.

5. Substantiate: validating findings with external sources (government counterparts, peer organizations) in 2021 and 2023.
6. Use findings: informing adaptive management and learning.

Each outcome was recorded using a standardized template, ensuring consistency and completeness. Substantiation largely confirmed the accuracy of the outcomes (Wakia & Safronova, 2025). After the outcomes were validated, they were subjected to a second layer of categorization using the Six Conditions for Systems Change framework (Kania et al., 2018). This involved mapping each outcome to one of the six conditions: policies, practices, resource flows, relationships and connections, power dynamics, or mental models.

The mapping was guided by the definitions of the conditions and examples provided in the framework. The analytical approach moved from identifying individual behavior changes to understanding their systemic significance by locating them within the Six Conditions framework. This integration made it possible to distinguish between explicit changes and deeper semi-explicit and implicit changes within the Collective Impact initiative.

4. Results and Discussion

The quantitative analysis of outcomes harvested in Moldova by January 2025 revealed that CTWWC documented 90 examples of actors changing their behavior as a result, at least in part, of CTWWC interventions (Wakia & Safronova, 2025). Government actors represented most outcomes, with 69 outcomes involving national or subnational government actors. This reflects the highly government-led nature of Moldova's care system and the initiative's strategic focus on strengthening government structures and processes. Residential care providers accounted for 9 outcomes, civil society actors for 4, faith-based actors for 3, people with lived experience networks for 3, and other actors for 2 outcomes (Wakia & Safronova, 2025).

To analyze the depth of these changes, each outcome was mapped to one of the six conditions of the Six Conditions for Systems Change framework (Kania et al., 2018) and assigned to the corresponding level of visibility. The resulting distribution is shown in Figure 2, which presents the number of outcomes by condition and actor type. Government actors dominated across all conditions, particularly in policies, practices, and power dynamics. Civil society and faith-based actors contributed to changes in policies and mental models, while people with lived experience (PWLE) were present in resource flows and mental models.

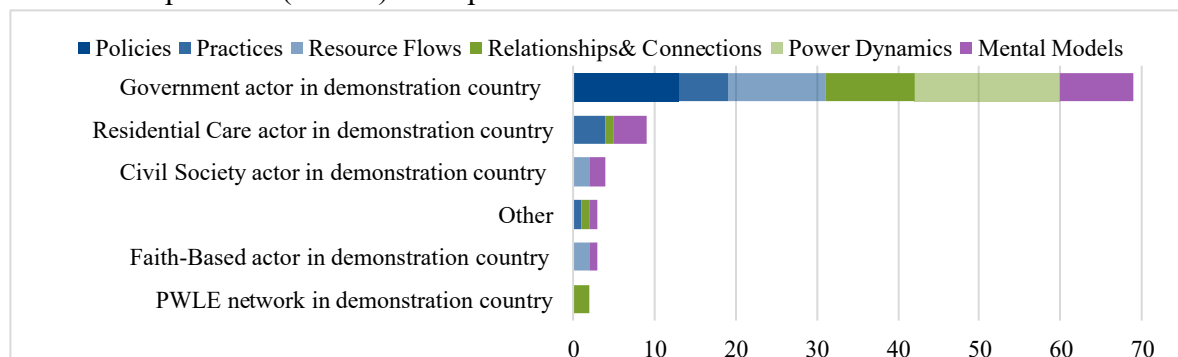


Figure 2. Number of outcomes in Moldova by condition and actor type (n = 90)

Source: Wakia, J., & Safronova, A. (2025). Outcome Harvesting within Changing the Way We Care: Report 2: Results and system strengthening learning. Catholic Relief Services.

When aggregated by level, the outcomes reveal a balanced spread across the three levels of systemic change (see Figure 3). The explicit level accounted for 40 outcomes. Within this level, resource flows (16 outcomes) were the most frequent, followed by policies (13 outcomes) and practices (11 outcomes). The semi-explicit level totaled 33 outcomes, with power dynamics (18 outcomes) outnumbering relationships and connections (15 outcomes). Finally, the implicit level accounted for 17 outcomes, representing the deepest and least visible form of change. The distribution suggests that the initiative was successful not only in producing visible structural changes but also in shifting relational dynamics and, to a notable degree, underlying mental models.

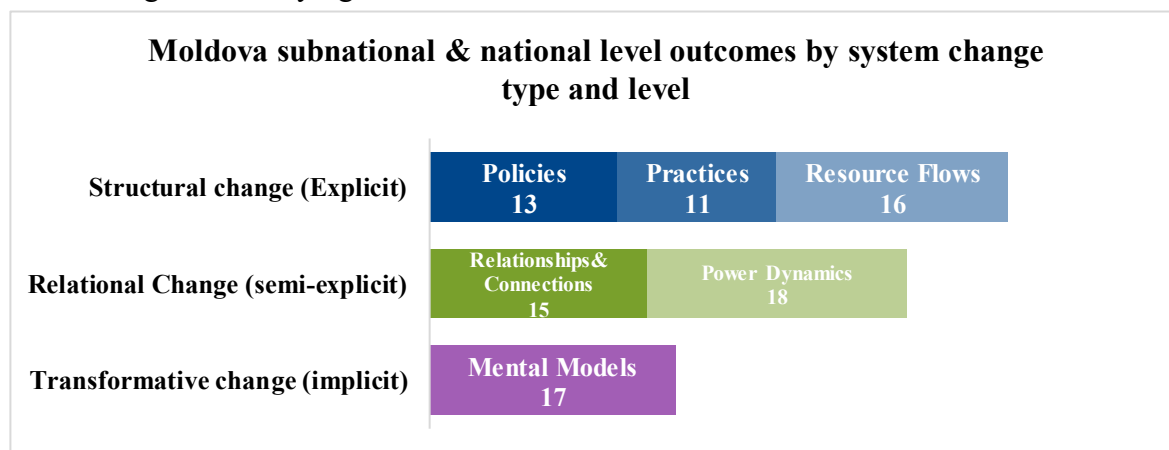


Figure 3. Number of outcomes in Moldova by system change type (n = 90)

Source: adapted from Wakia, J., & Safronova, A. (2025). Outcome Harvesting within Changing the Way We Care: Report 2: Results and system strengthening learning. Catholic Relief Services.

At the explicit level - changes in policies, practices, and resource flows, the analysis documented 40 outcomes. Within this category, 13 outcomes were policy changes, 11 were practice changes, and 16 were changes in resource flows. These represent the most visible transformations. The policy changes reflect a deepening commitment to care reform at the highest levels: the 2022 National Child Protection Program, the inclusion of foster care in the minimum social protection package (June 2022), and the presentation of deinstitutionalization plans (March 2025) (Wakia & Safronova, 2025).

Practice changes included improved child assessments, increased reintegration with follow-up support, expanded foster care services, and greater local government involvement in foster care decisions. The 16 resource flow changes, notably government financing for the social service workforce and budget reallocations toward family-based services, indicate that the initiative influenced not only policy but also tangible allocation of resources.

Challenges and Limitations

Several methodological challenges should be noted. First, outcomes had to be known or observed by a member of the CTWWC team, meaning outcomes occurring at a distance or through knock-on effects were unlikely to be included (Wakia & Safronova, 2025). Second, describing outcomes in a manner consistent with the methodology was challenging for team members, potentially affecting data completeness (Wakia & Safronova, 2025). Third, the inherent difficulty of observing and documenting mental model changes means that the four outcomes at this level likely underrepresent actual change. Fourth, classification inconsistencies between team members required careful

management and regular discussion (Wakia & Safronova, 2025). Despite these challenges, the dataset provides a rich foundation for analyzing the depth and quality of changes occurring within the Collective Impact initiative.

This study has several limitations. First, the analysis is based on outcomes documented by CTWWC team members, meaning that changes not observed or not considered important may have been missed. This introduces a potential observer bias. Second, the focus on Moldova limits the generalizability of findings, though the theoretical framework is applicable across contexts. Third, while the Six Conditions framework provides a valuable analytical lens, the categorization of outcomes into conditions inevitably involves subjective judgment.

5. Conclusions

This article has proposed the Six Conditions for Systems Change framework as an analytical tool for examining Collective Impact initiatives. Drawing on outcome-level monitoring data from a child care system strengthening initiative in the Republic of Moldova, the analysis has revealed changes across all three systemic levels.

At the explicit level, 40 outcomes documented new policies, improved practices, and notable resource flow shifts. At the semi-explicit level, 33 outcomes documented strengthened relationships and significant shifts in power dynamics, including the elevation of child protection to the Prime Minister's level. At the implicit level, 17 outcomes provided evidence of shifting mental models among professionals, local administrators, and the workforce.

The findings demonstrate that the Six Conditions framework meaningfully complements Collective Impact methodology by providing analytical depth and helping us see beneath the surface of collaboration. By focusing on all three levels of change, the integrated approach increases the potential for collaborative initiatives to achieve durable, systemic transformation (Kania et al., 2018).

For practitioners, the Moldova case offers several lessons. First, invest in relationships from the start, because they enable everything else. Second, together with key stakeholders, create spaces for co-creation, not just consultation. Third, track changes at all three levels, not just visible outputs. For policymakers, the findings underscore the importance of long-term engagement and adaptive management. Systemic change does not happen quickly, and funding cycles of two to three years are insufficient to support the kind of transformation documented in Moldova.

For researchers, this study suggests that combining Collective Impact with the Six Conditions framework offers a promising approach for evaluating complex social reforms. Future research could explore how the framework applies in other contexts and sectors, how mental model changes can be more effectively documented, and how the interplay between levels of change can be better understood.

In conclusion, the Six Conditions framework provides a practical and holistic tool for evaluating complex social reforms. By examining changes across all three levels, it helps distinguish between superficial adjustments and deep, lasting systemic transformation. Evidence from Moldova confirms that such transformation is possible but requires looking below the waterline.

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SOCIAL INCLUSION AS AN INSTRUMENT OF INTERNATIONAL STABILITY: MIGRATION, MINORITIES AND HUMAN SECURITY

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Abstract: *This article examines social inclusion as a strategic condition of international stability across the interconnected domains of migration governance, minority protection, and human security. It argues that the relationship between inclusion and stability is structural rather than merely situational: inclusion has stabilizing effects when it is institutionally grounded in legal security, equitable access to rights and services, meaningful participation, and the recognition of cultural and social difference. Under these conditions, inclusive policies reduce structural vulnerability, strengthen the legitimacy of public institutions, and mitigate intergroup tensions in diverse societies. Methodologically, the study employs a qualitative, explanatory, and comparative research design based on the analysis of academic literature, United Nations and European policy documents, and recent strategic frameworks from the Republic of Moldova. The findings show, first, that social inclusion remains conceptually contested and unevenly operationalized across governance levels. Second, they demonstrate that inclusion contributes to stability through three interrelated mechanisms: human security, governance legitimacy, and minority-rights recognition. Third, they indicate that recent policy developments in the Republic of Moldova increasingly frame inclusion not only as a social-policy concern, but also as a multisectoral issue linked to resilience, democratic governance, and regional security. By reconceptualizing social inclusion as an analytical and strategic variable at the intersection of rights, governance, and security, the article contributes to current scholarship and offers a framework relevant to both academic research and policy design in states affected by migration pressures, geopolitical uncertainty, and institutional transformation.*

Keywords: social inclusion; international stability; migration governance; human security; governance legitimacy; minority rights; Republic of Moldova.

Classification JEL: F22; I38; J15.

UDC: 316.4.063.3:314.74 **DOI:** <https://doi.org/10.53486/ser2026.24>

1. Introduction

In the context of intensified international migration, growing social diversity, and increasing vulnerabilities associated with regional insecurity and institutional transformation, social inclusion has become a major concern for both academic research and public policy. Yet, despite its frequent use in debates on migration, integration, cohesion, and rights protection, the concept remains analytically unstable and unevenly operationalized across governance levels. It is often invoked as a normative ideal, but far less consistently defined as a category capable of explaining how access, participation, recognition, and legal security shape broader outcomes of resilience and stability. This conceptual indeterminacy weakens policy evaluation and obscures the mechanisms through which inclusion may affect institutional legitimacy, social cohesion, and the management of diversity in contexts marked by mobility and uncertainty.

Against this background, the present article examines social inclusion not simply as a social-policy objective, but as a strategic and analytical variable situated at the intersection of migration governance, minority protection, and human security. The central argument is that the relationship between inclusion and stability is structural rather than situational. Inclusion contributes to stability when it is institutionally grounded in legal security, equitable access to rights and services, meaningful participation, and the recognition of cultural and social difference. Under these conditions, inclusion reduces structural vulnerability, strengthens governance legitimacy, and mitigates the forms of exclusion that can deepen fragmentation and intergroup tension. The article therefore addresses the following research question: through what mechanisms does social inclusion contribute to stability and resilience in societies affected by migration pressures, diversity, and institutional change?

To answer this question, the study employs a qualitative, explanatory, and comparative research design based on the analysis of academic literature, international and European policy documents, and recent strategic frameworks from the Republic of Moldova. This approach makes it possible to examine both the conceptual evolution of inclusion and its policy translation across different governance contexts. Particular attention is given to the Republic of Moldova as a case of institutional transition in which migration governance, European integration, and regional insecurity increasingly intersect. In this setting, inclusion is becoming more visible not only as a matter of social support, but also as a component of resilience-oriented governance.

The originality of the article lies in reconceptualizing social inclusion as a mechanism that links three dimensions often discussed separately in the literature: human security, governance legitimacy, and minority-rights recognition. By bringing these dimensions into a single analytical framework, the article seeks to move beyond narrower approaches that treat inclusion primarily as a welfare objective or a humanitarian principle. Instead, it argues that inclusion should also be understood as part of the institutional conditions under which diverse societies remain cohesive, legitimate, and resilient.

The article is structured as follows. The first section reviews the relevant literature and identifies the main conceptual and analytical gaps in existing scholarship. The second outlines the methodological approach and explains the logic of corpus selection and comparative interpretation. The third presents the main findings and discusses the mechanisms through which inclusion contributes to stability across different governance contexts. The final section summarizes the principal conclusions, reflects on the limits of the study, and suggests directions for further research.

2. Literature Review

The literature increasingly treats social inclusion as a central concept in debates on migration, minority protection, and social cohesion, yet its analytical status remains unstable. While the term is widely invoked in both academic and policy discourse, it is often used as an umbrella notion covering equality, participation, non-discrimination, access to services, and belonging, without sufficient precision regarding its core dimensions, indicators, or expected effects. As Koehler et al. (2020), the International Organization for Migration (IOM, 2017), and Ben Brik and Brown (2024) suggest, this conceptual breadth has normative appeal but analytical costs: it complicates policy evaluation, weakens

comparability, and obscures the mechanisms through which inclusion may shape wider outcomes such as social cohesion, institutional legitimacy, and resilience.

A major point of divergence in the literature concerns the relationship between inclusion and integration. In some works, the two are used almost interchangeably, whereas in others inclusion is treated as either a component, a precondition, or a possible outcome of broader integration processes. Belugina et al. (2018) note the absence of a settled understanding of what inclusion requires in practical terms and how it evolves into successful integration. This ambiguity is reinforced by the persistence of competing normative paradigms in European debates, including assimilation, multiculturalism, equality-based integration, and cohesion-oriented approaches. Spencer (2006) show that these paradigms allocate responsibility differently between migrants, institutions, and host societies, thereby producing distinct models of adaptation, participation, and belonging. The literature therefore remains divided not only on what inclusion means, but also on how it should be operationalized and by whom.

At the same time, existing research converges on the view that social inclusion is multidimensional and cannot be reduced to economic incorporation alone. Access to employment remains important, but the literature increasingly emphasizes that inclusion also depends on education, health care, housing, legal protection, cultural recognition, and civic participation. Malloy and Gazzola (2006) demonstrate that cultural and linguistic recognition are not secondary add-ons, but constitutive elements of inclusion for minorities. Similarly, Koehler et al. (2020) argue that inclusion must be understood within broader structures of power, inequality, and rights, and that purely administrative or compensatory approaches are insufficient. However, while the literature acknowledges this multidimensionality, it does not always specify how these dimensions interact or which of them are most decisive in producing broader social and political effects.

A further strand of scholarship links inclusion directly to vulnerability, rights, and human dignity. In migration studies, exclusion is frequently associated with precarious legal status, weak social networks, discrimination, and limited access to essential services. Bass (2018) highlights the structurally vulnerable position many migrants occupy in receiving societies, while OHCHR (2017) stresses that inadequate rights-based governance leaves migrants disproportionately exposed to exclusion, exploitation, and insecurity. The IOM (2017) likewise frames integration and cohesion in terms of effective access to education, health care, decent work, and legal protection. Yet an important analytical issue remains insufficiently resolved: much of this literature convincingly shows why exclusion is harmful, but it is less precise in demonstrating how inclusion becomes a stabilizing mechanism rather than simply a normative corrective.

The literature on social cohesion provides a partial answer by linking inclusion to belonging, trust, and public attitudes toward diversity. Bauloz et al. (2020) argue that inclusion is central to the migration cycle because it shapes not only migrants' access to rights, but also the quality of coexistence in receiving societies. At the same time, anti-immigration sentiment, racism, xenophobia, and securitized political narratives can undermine both inclusion and cohesion. Giampaolo and Ianni (2020) extend this perspective by treating migrant inclusion as a cross-sectoral issue connected to labour, urban governance, and sustainable development. However, the literature remains less clear on whether cohesion should be understood as an outcome of inclusion, a parallel process, or an intervening condition mediating between policy frameworks and stability outcomes.

This unresolved relationship weakens attempts to explain why similar inclusion measures may produce different effects across contexts.

The security literature introduces a further shift by framing inclusion in relation to human security rather than solely migration management. Bilgic (2018) argues that a human security approach reorients analysis from the protection of borders to the protection of persons, emphasizing freedom from fear, freedom from want, and human dignity. Lami and Kojku (2025) similarly show that migration governance may move beyond a state-centred security paradigm toward a more human-centred understanding.

However, this shift is not linear or uncontested. Häkli and Peltonen (2026) demonstrate that the European Union's New Pact on Migration and Asylum combines humanitarian language with practices of control, categorization, and selective protection, thereby reproducing vulnerability even within formally protective frameworks. This critical literature is particularly valuable because it shows that inclusion cannot be inferred from rhetoric alone: rights-based discourse may coexist with exclusionary institutional arrangements, and humanitarian framing does not automatically translate into durable inclusion.

In the case of the Republic of Moldova, the literature is more limited, but recent strategic documents suggest an emerging attempt to embed inclusion within a broader governance and resilience framework. The draft national programme on the staged integration of foreigners, including displaced persons, for 2025–2027 presents integration as a multisectoral process involving education, health, labour-market access, housing, culture, social protection, and community participation (Ministry of Internal Affairs of the Republic of Moldova, 2025).

The draft National Programme on Migration and Asylum for 2026–2030 further links migration governance to European Union alignment, institutional development, regional security pressures, and a combined logic of protection, regulation, and integration (Government of the Republic of Moldova, 2025). In parallel, the United Nations Sustainable Development Cooperation Framework for the Republic of Moldova 2023–2027 places inclusion, resilience, and equal opportunities at the centre of the national development agenda (United Nations in Moldova & Government of the Republic of Moldova, 2022). These documents suggest a gradual conceptual broadening, yet they remain primarily programmatic and do not by themselves resolve the analytical question of how inclusion contributes to stability.

Taken together, the literature shows three things. First, social inclusion is widely recognized as normatively desirable but remains conceptually fragmented. Second, important progress has been made in linking inclusion to rights, vulnerability, cohesion, and human security, yet the relationship between these dimensions is still insufficiently theorized. Third, existing studies do not adequately clarify the mechanisms through which inclusion contributes to institutional resilience and social stability, especially in contexts marked by migration pressures, geopolitical uncertainty, and institutional transformation. This article departs from prior approaches by treating social inclusion not merely as a social-policy objective or a humanitarian aspiration, but as an analytical and strategic variable connecting human security, governance legitimacy, and minority-rights recognition to international stability. In doing so, it seeks to address a significant gap in the literature and to provide a more integrated framework for understanding inclusion in contemporary societies.

3. Methodology

This article employs a qualitative, explanatory, and comparative research design in order to examine how social inclusion functions as a mechanism linking migration governance, minority protection, and human security to broader outcomes of stability and resilience. The study is based on document analysis, since the research objective is not to measure a single empirical variable, but to clarify the conceptual framing, normative evolution, and policy operationalization of inclusion across different governance contexts.

The empirical corpus consists of fifteen key sources, including peer-reviewed journal articles, book chapters, international and European policy documents, and recent strategic frameworks from the Republic of Moldova. Sources were selected according to three main criteria: conceptual relevance to social inclusion, direct connection to migration or minority protection, and analytical usefulness for understanding the relationship between inclusion and stability. Preference was given to recent and authoritative materials, while several earlier works were retained because they provide foundational distinctions still relevant to the debate. Sources were excluded where inclusion was addressed only marginally or without clear relevance to the stability dimension.

The corpus covers publications and policy documents issued mainly between 2003 and 2026. This temporal range makes it possible to capture both the longer evolution of the concept and its more recent reformulation in the context of intensified migration, regional insecurity, and institutional transformation. The documents were coded around the following categories: social inclusion, integration, social cohesion, migration governance, minority rights, human security, vulnerability, participation, recognition, legal security, and stability. The analysis was then organized around three principal dimensions: human security, governance legitimacy, and minority-rights recognition.

To make the comparative argument more explicit, the study uses Germany, Sweden, and France as European reference cases, alongside the Republic of Moldova. These cases were selected not to produce an exhaustive country comparison, but to provide analytically contrasting models of inclusion governance. By contrast, the category “Eastern European states” used in Table 1 is not treated as a single case in the strict methodological sense, but as a synthetic regional benchmark derived from comparative literature and policy overviews. Its function is heuristic, allowing the Moldovan case to be situated within a broader regional context of more uneven and fragmented inclusion frameworks.

Social inclusion was assessed through qualitative indicators recurrently identified across the literature and policy corpus, including access to education, employment, health care, housing, legal protection, social assistance, cultural recognition, civic participation, and anti-discrimination safeguards. Stability was treated as a broader analytical construct reflected in reduced vulnerability, lower intergroup tensions, stronger social cohesion, improved institutional trust, and enhanced governance resilience. In this sense, the methodological objective is not to establish direct statistical causality, but to identify recurring institutional patterns and plausible mechanisms through which inclusion may contribute to stability.

This approach is appropriate because it connects conceptual debates, normative frameworks, and policy developments within a single analytical structure and allows comparison not only of policy measures, but also of the governance logics underlying them. At the same time, the study has clear limits. Because it relies on qualitative document analysis, it does not provide

definitive causal proof, and the Moldova-specific evidence remains largely programmatic due to the recency of the national documents examined. The findings should therefore be read as a theoretically grounded and policy-relevant interpretation rather than as a final causal demonstration.

4. Results and Discussion

The document analysis confirms that the central issue is not whether social inclusion matters, but how it is conceptualized, operationalized, and institutionally embedded across different governance contexts. Across both the academic literature and the policy corpus examined, inclusion remains a normatively powerful but operationally uneven category. This matters because the stabilizing effects often attributed to inclusion cannot be assessed convincingly where the concept itself is weakly delimited or inconsistently translated into policy instruments. The findings therefore suggest that inclusion contributes to stability only under specific institutional conditions, which become visible through three interrelated dimensions: human security, governance legitimacy, and minority-rights recognition.

For the purposes of this analysis, social inclusion is understood as the effective incorporation of migrants and minorities into the main institutional and social spheres of the receiving society, including access to rights, services, protection, and public life. Integration is treated as the broader process of mutual adaptation between migrants and host societies, while social cohesion refers to the degree of trust, solidarity, and shared belonging that sustains coexistence in diverse communities (Bauloz et al., 2020; IOM, 2017; Spencer, 2006). This distinction is analytically important because it allows the discussion to move beyond terminological overlap and to focus instead on the mechanisms through which inclusion affects resilience and stability.

A first finding is that conceptual elasticity is not a merely semantic problem; it has direct methodological and political consequences. Across the corpus, social inclusion functions as a broad umbrella term, but the criteria by which it is assessed vary substantially across policy domains and institutional settings. As Ben Brik and Brown (2024) show, inclusion may encompass education, labour-market access, housing, health, and participation, yet the absence of sufficiently harmonized measurement frameworks makes comparative assessment difficult. This ambiguity weakens the evidentiary basis of claims that inclusion strengthens resilience, cohesion, or legitimacy, because the object being evaluated is not always defined in comparable terms. In this sense, one of the most significant findings of the analysis is that the instability of the concept itself partially explains the instability of the policy outcomes associated with it.

A second finding concerns the tension between rights-based and resilience-oriented policy frames. In the documents reviewed, inclusion is presented either as an obligation derived from equality, dignity, and non-discrimination, or as an instrument for managing diversity, reducing tensions, and strengthening institutional capacity. These two frames are not necessarily incompatible, but they produce different emphases and sometimes different policy logics. The rights-based frame prioritizes legal protection, equal access, and recognition, whereas the resilience-oriented frame emphasizes coordination, programmability, and the capacity of institutions to absorb social pressures. The analysis shows that inclusion is most effective where these two logics converge. By contrast, where

inclusion is framed only rhetorically, without legal guarantees, participation mechanisms, and implementation capacity, its stabilizing potential remains limited.

This becomes particularly clear in relation to the institutional architecture of inclusion. The findings suggest that inclusion is most likely to have stabilizing effects when it is embedded in coordinated, multi-level, and cross-sectoral governance arrangements rather than in fragmented or compensatory interventions. Inclusion cannot be reduced to a single policy field, because exclusion itself operates across multiple and mutually reinforcing domains. Where legal status, access to services, language support, labour-market integration, education, social protection, and participation are addressed through a broader strategic framework, inclusion is more likely to produce durable effects. Where, by contrast, policies remain sectoral, weakly coordinated, or reactive, the result is often uneven implementation, weak monitoring, and reduced long-term impact. This finding reinforces the broader argument that the stabilizing value of inclusion is institutional before it is rhetorical.

The analysis further shows that the relationship between inclusion and stability operates through three mutually reinforcing mechanisms.

First, inclusion strengthens human security by reducing structural vulnerability. Migrants and minorities with access to legal protection, education, housing, health care, justice, and employment are less exposed to marginalization, dependency, abuse, and exploitation (IOM, 2017; OHCHR, 2017). In this sense, inclusion functions not simply as social accommodation, but as a preventive security mechanism. It reduces the conditions under which exclusion may escalate into insecurity, distrust, grievance, or long-term social fragmentation. This supports the human security literature, which shifts the focus from the protection of borders to the protection of persons and communities (Bilgic, 2018). At the same time, the analysis confirms the warnings of critical scholarship: human-centred rhetoric does not automatically guarantee protective outcomes, especially where legal precarity and selective categorization remain embedded in migration governance (Häkli & Peltonen, 2026).

Second, inclusion reinforces governance legitimacy. Public institutions are more likely to be perceived as legitimate when they are accessible, predictable, non-discriminatory, and capable of responding to the needs of diverse populations. This legitimacy is not produced by service delivery alone, but by the broader perception that institutions operate according to principles of fairness, equal treatment, and participation. The findings therefore support the argument that integration is sustainable only when it is conceived as a reciprocal and institutionally mediated process rather than as unilateral adaptation by migrants alone (Spencer, 2006). In practical terms, inclusion contributes to stability because it reduces the gap between formal rights and lived institutional experience, thereby strengthening trust in governance structures.

Third, inclusion contributes to stability through minority-rights recognition. The evidence reviewed shows that social cohesion cannot be sustained through socioeconomic incorporation alone if cultural, linguistic, and identity-based dimensions of belonging remain unrecognized. Malloy and Gazzola (2006) make clear that cultural participation and equal recognition are not secondary supplements to inclusion, but core dimensions of it. Policies that require conformity at the expense of difference may produce formal incorporation, but they rarely generate substantive belonging. By contrast, where equal access is combined with recognition, participation, and anti-discrimination guarantees,

diversity is less likely to be experienced as a destabilizing factor and more likely to be integrated into the social fabric in durable ways.

The comparative evidence also indicates that policy effectiveness depends less on the existence of isolated inclusion measures than on the coherence of the overall inclusion architecture. Germany and Sweden illustrate relatively consolidated models in which strategic planning, multi-level coordination, and policy continuity reinforce inclusion outcomes across multiple domains. France reflects a different but still structured model, in which universalist principles coexist with targeted territorial and post-2015 inclusion measures. By contrast, the weaker institutionalized Eastern European settings synthesized in the analysis reveal greater fragmentation, weaker participation channels, and more limited monitoring capacity. This does not mean that Western European cases are normatively superior in all respects, but it does show that inclusion becomes more credible and more effective where access, coordination, and participation are linked within a broader governance framework.

Within this comparative landscape, the Republic of Moldova appears as an emerging case of programmatic inclusion. The recent draft programmes examined do not yet constitute a fully consolidated inclusion architecture, but they do indicate an important conceptual shift. Inclusion is increasingly framed not only in relation to basic service provision, but also in relation to institutional resilience, governance capacity, European alignment, and regional security pressures (Government of the Republic of Moldova, 2025; Ministry of Internal Affairs of the Republic of Moldova, 2025). This is analytically significant because it suggests that Moldova is beginning to move from a narrow social-policy understanding of inclusion toward a broader strategic one. The Moldovan case is therefore relevant not as a finished model, but as a case of institutional transition in which the stabilizing logic of inclusion is becoming more explicit at the policy level.

To make the comparative argument more explicit, Table 1 synthesizes the main documentary findings on the architecture of inclusion and its stability-relevant effects across selected European cases and the Republic of Moldova. The comparison focuses on policy scope, institutional coordination, legal security, sectoral domains of inclusion, cultural recognition, civic participation, and the documented or anticipated implications for cohesion and stability. The table does not claim exhaustive equivalence of cases; rather, it serves as a structured analytical device for identifying broader patterns in the relationship between inclusion, resilience, and fragmentation.

Before presenting the comparative grid, it is necessary to underline that the relevance of comparison in this article lies less in ranking national models than in clarifying the institutional conditions under which inclusion acquires stabilizing effects. The cases selected for discussion illustrate different ways in which inclusion is embedded in governance structures, legal regimes, and sectoral policy arrangements. What emerges from the analysis is that inclusion cannot be reduced to isolated support measures or to declarative commitments in policy documents. Its effects depend on the coherence of the wider institutional architecture through which rights, services, participation, and recognition are organized and made accessible.

A comparative synthesis is therefore useful because it makes visible the differences between more consolidated and more fragmented frameworks, while also showing that policy effectiveness depends on coordination, implementation capacity, and continuity over time.

In this sense, the table below should be read as a structured analytical instrument designed to capture broader patterns in the relationship between inclusion, resilience, and stability across different European settings and the Republic of Moldova.

Table 1. Document-based comparative grid of inclusion architecture and stability-relevant effects

Indicator	Germany	Sweden	France	Eastern European states	Republic of Moldova
Policy design	Comprehensive multi-domain strategy	Mainstreamed integration with targeted support	Universal access with targeted post-2015 measures	Uneven or partial frameworks	Emerging multi-domain programmes
Institutional coordination	Strong federal coordination and monitoring	Mainstream coordination with labour-market focus	Multi-level national-local coordination	Fragmented, with limited strategic coherence	Programme-based coordination with action plans
Legal security and access	Structured inclusion linked to residence status	Residence-based access with targeted support	Documented migrants and refugees prioritized	Narrow, status-based access	Focus on foreigners and displaced persons
Socio-economic inclusion	Strong emphasis on education and employment	Language learning, civic orientation, rapid employment	Universal services with targeted refugee support	Uneven provision, especially in training and education	Labour-market measures and vulnerability-sensitive social support
Recognition and participation	Present but uneven across levels	Stronger participation environment	Local cohesion and participation measures	Weaker participation and limited consultative mechanisms	Early-stage inclusion agenda with cohesion objectives
Stability-related effects	Stronger inclusion infrastructure through coordination and monitoring	Broad participation supports cohesion	Local measures reduce isolation and strengthen interaction	Weak monitoring and fragmented policies increase cohesion risks	Inclusion framed as part of resilience and stabilization

Source. Compiled by the authors based on EU country integration overviews, OECD (2018); Solano & Huddleston (2020); Government of the Republic of Moldova (2025); Ministry of Internal Affairs of the Republic of Moldova (2025).

Several policy implications follow from these findings. *First*, legal security should be treated as a foundational condition of inclusion, because migration status structures access to rights, services, remedies, and long-term participation across all other domains. Where status remains precarious, vulnerability is reproduced institutionally. Predictable residence pathways, transparent regularization mechanisms, and clear long-term status rules should therefore be understood not only as instruments of migration management, but also as elements of stability infrastructure.

Second, inclusion requires integrated governance and coherent monitoring frameworks. The analysis confirms that fragmented interventions are rarely sufficient to generate durable stabilizing effects. In this respect, the European Commission's Action Plan on Integration

and Inclusion 2021–2027 is significant because it frames inclusion as a cross-sectoral, multi-level policy priority rather than as a narrow question of service access alone (European Commission, 2020). What matters is not merely the existence of measures, but their coordination across education, employment, health, housing, equality, and participation.

Third, effective inclusion depends on robust multi-level coordination. Evidence from OECD research shows that migrant integration is shaped decisively at the local level and requires stronger vertical coordination, policy coherence, and assessment tools for implementation (OECD, 2018). This implication is especially relevant for the Republic of Moldova, where emerging strategies will have limited impact unless inter-ministerial planning, municipal capacity, and evaluation mechanisms are connected more systematically.

Fourth, participation and cultural recognition should be treated as core, not peripheral, dimensions of inclusion. The MIPEx findings show that political participation remains among the weaker dimensions of integration across Europe, particularly across the East-West divide (Solano & Huddleston, 2020). At the same time, comparative work on cultural inclusion indicates that the underrepresentation of cultural dimensions weakens the overall architecture of inclusion (Malloy & Gazzola, 2006). The analysis therefore supports a broader understanding of inclusion in which belonging, recognition, and participation are integral to resilience and cohesion rather than optional normative supplements.

The study also has limitations. Because it is based on qualitative document analysis, it does not provide direct causal proof of the effects of specific inclusion policies on stability outcomes. Rather, it identifies plausible mechanisms, recurring policy patterns, and institutional conditions under which inclusion is more or less likely to produce stabilizing effects. Cross-country interpretation also remains constrained by differences in national models, policy objectives, and degrees of institutional consolidation. In the Moldovan case, the evidence is still largely programmatic, since the documents examined are recent and provide limited ex post evaluation.

Future research would benefit from combining document analysis with longitudinal and mixed-method approaches, including subnational case studies, outcome indicators, and comparative evidence on trust, participation, and resilience over time. Such work would make it possible to test more precisely the mechanisms identified here and to assess under what conditions inclusion succeeds or fails as an instrument of stability in contexts shaped by migration, insecurity, and institutional transformation.

5. Conclusions

This article has argued that social inclusion should be understood not merely as a normative aspiration of migration and diversity policies, but as a strategic condition of international stability. The analysis shows that inclusion has stabilizing value when it is institutionally grounded in legal security, equitable access to rights and services, meaningful participation, and the recognition of cultural and social difference. Under these conditions, inclusion reduces structural vulnerability, strengthens the legitimacy of public institutions, and mitigates the forms of exclusion that can deepen fragmentation and intergroup tension. Conversely, where inclusion remains fragmented, weakly coordinated, or predominantly rhetorical, its capacity to generate resilience is significantly reduced.

The article contributes to the literature in three principal ways. *First*, it clarifies that the relationship between inclusion and stability is structural rather than situational. Inclusion does not matter only in exceptional moments of crisis; it shapes, more fundamentally, the quality of governance, the distribution of vulnerability, and the conditions of coexistence in diverse societies. *Second*, the study identifies three interrelated mechanisms through which inclusion contributes to stability: human security, governance legitimacy, and minority-rights recognition. *Third*, it advances a more integrated analytical understanding of social inclusion by locating it at the intersection of rights, governance, and security, thereby moving beyond narrower approaches that treat it primarily as a social-policy objective.

The findings are particularly relevant for the Republic of Moldova and for other states confronted simultaneously with migration pressures, regional insecurity, and institutional transformation. In such contexts, inclusion should not be approached as a secondary humanitarian response or as a limited welfare issue, but as part of a broader strategy of democratic resilience and societal stability. Policies are more likely to produce durable stabilizing effects where they are coherent across sectors, supported by predictable legal frameworks, connected to effective institutional coordination, and open to meaningful participation by the groups concerned. In this sense, inclusion should be seen less as an adjunct to governance and more as one of the conditions of governance effectiveness under conditions of diversity and uncertainty.

At the same time, the study has important limitations. Because it relies on qualitative document analysis, it does not establish direct causal proof between specific inclusion measures and stability outcomes. Its contribution lies instead in identifying recurrent mechanisms, institutional patterns, and plausible relationships that help explain why inclusion may function as a stabilizing force in some contexts and not in others. Comparative interpretation is also constrained by differences in national policy models, conceptual vocabularies, and degrees of institutional consolidation. In the case of the Republic of Moldova in particular, the available evidence remains largely programmatic, since many of the national documents examined are recent and have not yet generated sufficiently robust evaluative data.

Future research should therefore move beyond documentary analysis alone and combine it with longitudinal, comparative, and mixed-method approaches capable of assessing more precisely how inclusion affects trust, participation, vulnerability, and resilience over time. Greater attention should also be given to subnational implementation, since the stabilizing effects of inclusion depend not only on national policy design, but also on institutional capacity and social interaction at the local level. Such research would make it possible to test more rigorously the argument advanced here: namely, that social inclusion is not simply a normative good, but an analytically significant and politically consequential variable in the production of stability under contemporary conditions of mobility, insecurity, and institutional change.

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A CONFIGURATIONAL MACRO-FRAMEWORK LINKING CIRCULAR MATERIALIZATION AND INTERNATIONALIZATION OUTCOMES

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Abstract: *This paper proposes a macro-comparative framework for examining how circular materialization relates to internationalization outcomes under conditions of uneven indicator availability and limited case numbers. To preserve level consistency, internationalization outcomes are approached through international economic positioning, understood as a macro-level expression of a country's external economic profile. The framework distinguishes between an economy's internal structural profile - institutional setting, innovation capacity, and circular materialization - and its external economic profile, captured through international economic positioning. Two conceptual boundaries are clarified: between circularity as a broader systemic horizon and circular materialization as a narrower construct focused on observable aggregate material outcomes, and between firm-level internationalization behaviour and macro-level international economic positioning. Methodologically, the paper introduces a two-tier indicator architecture, combining a parsimonious comparative core with validating indicators for contextual interpretation, supported by transparent procedures for standardization, aggregation, and stability checks. An illustrative application using a reduced indicator set for Germany, Bulgaria, and Romania demonstrates how comparative profiles can reveal patterns of alignment and divergence across countries, even under constrained data conditions. Designed for small-N analysis, the framework functions as a diagnostic comparative template rather than a causal model, while remaining open to later empirical application and theoretical elaboration.*

Keywords: *circular materialization; international economic positioning; comparative profiling; composite indicators; comparative framework.*

Classification JEL: C43; F63; Q56.

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1. Introduction

Circular economy strategies are increasingly discussed not only in environmental terms, but also in relation to competitiveness, resilience, and broader sustainability-oriented transformation. At the macro-comparative level, research faces a persistent gap between conceptual breadth and empirical observability, as internationally comparable indicators capture only selected dimensions of circularity (Geissdoerfer et al., 2017; Kirchherr et al., 2017; Korhonen et al., 2018; Moraga et al., 2019). Cross-country comparability is further constrained by differences in definitions, measurement approaches, and data availability (OECD, 2024; Saidani et al., 2019).

To address this, the paper distinguishes between circularity - the broader systemic horizon of transformation - and circular materialization, which focuses on observable aggregate material outcomes. This distinction allows for tractable comparative analysis under current data constraints.

A parallel challenge arises in assessing countries' outward-oriented economic profiles at the macro level. Firm-level concepts such as learning, commitment, and opportunity-driven expansion (Johanson & Vahlne, 1977, 2009; Oviatt & McDougall, 2005) are primarily designed to explain firm behaviour and therefore do not translate directly to macro-level analysis, where the focus shifts from behavioural processes to structural economic characteristics. Instead, features such as export breadth, export sophistication, value-added

trade participation, and broader forms of international connectedness provide more appropriate proxies for capturing countries' external economic structure.

Taken together, these considerations point to a broader comparative gap: although circular economy research, macro-level internationalization, and composite-indicator methodology offer important insights, they remain insufficiently integrated in frameworks that connect observable material outcomes with outward-oriented economic positioning.

This paper addresses the gap by proposing a comparative profile-analytical framework that connects internal structural conditions - including institutional setting, innovation capacity, and circular materialization - to external economic outcomes. Designed for small-N, data-constrained settings, it combines a parsimonious core of indicators with contextual validation to support structured, level-consistent comparison.

The contribution is both conceptual and methodological. Conceptually, the paper distinguishes circularity from circular materialization and macro-level economic positioning from firm-level internationalization behaviour. Methodologically, it introduces a two-tier indicator architecture with transparent procedures for standardization, aggregation, and stability checks, providing a structured template for analysing alignment and divergence in countries' internal and external economic profiles.

2. Literature Review

The literature relevant to this paper is rich but fragmented, offering insights for linking material transformation to outward-oriented economic profiles while leaving significant gaps at the macro level.

Circular economy is widely understood as a systemic alternative to linear “take-make-dispose” models, emphasizing value retention through reuse, repair, remanufacturing, recycling, and broader resource-efficiency strategies. Its diffusion across multiple fields has promoted adoption but generated ambiguity regarding definitions, system boundaries, and units of analysis (Geissdoerfer et al., 2017; Kirchherr et al., 2017). At the macro level, empirical work relies on partial proxies such as resource productivity, waste intensity, and recycling-related recovery, which capture only selected aspects of circular transformation and reflect heterogeneous measurement approaches and system boundaries (Moraga et al., 2019; Saidani et al., 2019). These issues, combined with differences in data availability and statistical frameworks, limit cross-country comparability (OECD, 2024).

Internationalization research faces a related challenge. Traditional theory explains internationalization through firm-level processes such as learning, commitment, and opportunity-driven expansion (Johanson & Vahlne, 1977, 2009; Oviatt & McDougall, 2005). These concepts do not directly translate to macro-level analysis, where the focus shifts to structural patterns such as export breadth, sophistication, value-added trade participation, and broader forms of international connectedness. These can be interpreted as aspects of a country's external economic structure, drawing on measures of economic complexity and comparative advantage (Hausmann et al., 2007; OECD, n.d.). Level-consistent constructs are therefore essential for analysing macro-level internationalization outcomes.

Finally, comparative reasoning and composite-indicator methodology provide useful tools for analysing multidimensional macro-level phenomena. Both material transformation and external economic positioning are shaped by institutional and innovation-related conditions,

which limits the usefulness of single-variable approaches. Composite indicators can organize heterogeneous measures, but only when decisions regarding indicator selection, normalization, weighting, aggregation, and robustness are transparent (Nardo et al., 2005; OECD, 2008). Without such rigor, composite measures risk overstating precision, especially when data coverage is uneven.

Together, these strands highlight a persistent gap in macro-comparative research: the lack of a coherent framework that integrates observable material outcomes of circularity with structural representations of countries' external economic positioning under conditions of uneven data availability.

3. Methodology

This paper develops a comparative profile-analytical framework for small-N cross-country comparison rather than statistical generalization. Its primary purpose is to examine how circular materialization relates to internationalization outcomes at the macro level under conditions of limited cases and uneven indicator availability. Under these constraints, the analysis does not aim to estimate causal effects or isolate the net impact of individual variables. Instead, it seeks to identify comparative patterns in terms of profile alignment, divergence, and consistency across analytically distinct dimensions. Operationally, this involves constructing and comparing country profiles across institutional, innovation, material, and external economic dimensions. The framework serves as a structured template for small-N comparative application, emphasizing diagnostic interpretation under data constraints. It therefore emphasizes analytical clarity over statistical inference, prioritizing structured interpretation and diagnostic insight.

The methodological design follows several guiding principles. First, all constructs are aligned with the macro level, ensuring cross-country comparability while avoiding direct import of firm-level behavioural categories. Second, parsimony is prioritized by focusing on a coherent core set of indicators, which improves interpretability under uneven data availability and reduces noise from less reliable measures. Third, the framework maintains full transparency in indicator selection, directionality, aggregation, and basic stability checks, ensuring that all methodological choices are explicit and reproducible.

The framework distinguishes between the economy's internal structural profile and its external economic profile. The internal profile comprises institutional setting (IS), innovation capacity (IC), and circular materialization (CM), capturing enabling conditions and observable material outcomes. CM is treated as a macro-level proxy for material outcomes rather than a full representation of circularity, reflecting limitations in available indicators. The external economic profile is represented by international economic positioning (IEP), capturing structural characteristics such as export breadth, export sophistication, trade participation, and international connectedness. IEP provides a level-consistent aggregate measure distinct from firm-level internationalization behaviour.

Analytically, the framework compares these internal and external profiles to assess whether different configurations of enabling conditions and material outcomes correspond to particular forms of external economic positioning. This comparison is pattern-oriented and configurational, allowing multiple internal-external combinations without implying deterministic or causal relationships. By systematically contrasting institutional setting,

innovation capacity, and circular materialization with international economic positioning, the framework enables identification of alignment, divergence, or partial correspondence across countries. Figure 1 illustrates this logic, showing how internal structural components are positioned relative to external economic outcomes, providing a visual reference for the subsequent analytical interpretation.

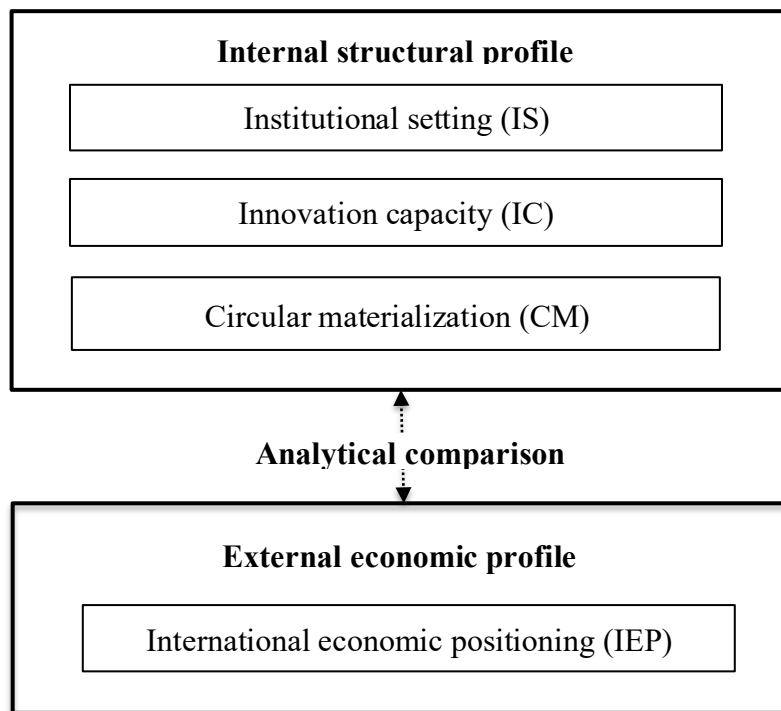


Figure 1. Analytical comparison between the economy's internal structural profile and external economic profile.

Source: Developed by author.

Empirically, the framework relies on secondary data from internationally comparable sources, including Eurostat, OECD databases, World Bank indicators, and World Integrated Trade Solution trade data, supplemented by national statistical sources where necessary. Case selection is limited to countries with sufficient overlap in core indicators across the analytical period, and indicators are summarized into period-representative statistics (typically means), reducing sensitivity to short-term fluctuations.

To address uneven data availability, the framework adopts a two-tier indicator logic. A parsimonious set of core indicators constructs comparative profiles for IS, IC, CM, and IEP, while a complementary set of validating indicators provides contextual interpretation without altering scores. Missing data are treated conservatively: indicators with limited coverage may be retained as interpretive measures, but no ad hoc imputation is applied.

Indicators are standardized using z-scores with harmonized directionality, while pressure indicators are sign-adjusted for consistency. Composite scores are constructed with equal weighting as a transparent baseline, producing dimension-specific results while leaving broader cross-dimensional interpretation analytical. Basic stability checks, including alternative normalization, modest weighting variations, and selective leave-one-out tests,

assess sensitivity to methodological choices and ensure robustness of comparative patterns (Nardo et al., 2005; OECD, 2008).

4. Analytical Outputs and Discussion

Given the conceptual and methodological scope of the paper, this section presents the analytical outputs generated by the proposed comparative profile-analytical framework, rather than finalized empirical findings. Its primary aim is to show how the framework structures cross-country comparison and supports interpretation in small-N settings, particularly where indicator availability is uneven. By integrating internal structural conditions, material outcomes, and external economic positioning into a coherent analytical system, the framework offers a transparent and level-consistent approach to examining circular materialization in relation to macro-level internationalization. The outputs are intended to support diagnostic interpretation by highlighting patterns of alignment and divergence without implying causal relationships.

The section is organized around three interrelated outputs that enable systematic comparison: (1) a comparative analytical model, which structures assessment across internal and external dimensions; (2) a two-tier indicator architecture, which operationalizes the model under conditions of uneven data availability; and (3) a baseline composite-index procedure, which standardizes and aggregates indicators while preserving interpretive clarity. Together, these outputs form a coherent framework for identifying patterns of alignment and divergence between internal structural conditions and external economic outcomes in small-N settings.

The first output, *the comparative analytical model*, establishes the conceptual foundation for cross-country comparison. It distinguishes between the economy's internal structural profile - comprising institutional setting (IS), innovation capacity (IC), and circular materialization (CM) - and its external economic profile, represented by international economic positioning (IEP). IS and IC function as enabling internal dimensions, while CM captures observable material outcomes. These internal dimensions are analytically contrasted with IEP, which reflects outward-oriented structural characteristics such as export breadth, sophistication, trade participation, and broader international connectedness.

By clarifying these boundaries, the model preserves consistency across macro-level comparisons. CM is treated as a bounded proxy for material outcomes rather than a full representation of circularity, while IEP reflects aggregate rather than firm-level outcomes, maintaining interpretability despite uneven data availability.

The model accommodates multiple configurations without implying a single causal pathway. Countries with similar external profiles may exhibit different internal patterns, while comparable internal conditions may correspond to different external outcomes. This flexibility enables the identification of alignment, divergence, and partial correspondence across cases, supporting nuanced comparative analysis rather than simplistic ranking.

Operationalizing the analytical model, the framework employs *a two-tier indicator architecture* designed for small-N, data-constrained settings. A core set of indicators constructs the main comparative profiles for IS, IC, CM, and IEP, while a complementary set of validating indicators provides contextual interpretation. These validating indicators do not affect core scores but help refine interpretation where data are available.

This architecture balances methodological rigor and interpretive clarity, enabling analytical comparability even when some indicators are partially available. It addresses a common challenge in macro-comparative research on circular economy and internationalization. By prioritizing a limited core set of indicators, the framework reduces noise associated with uneven data availability, while additional validating indicators provide contextual support for interpretation.

Table 1 summarizes the full two-tier indicator structure, distinguishing between core and validating measures and showing how each dimension is operationalized under uneven data conditions.

Table 1. Framework components and indicator architecture

Component	Core indicators	Validating indicators	Interpretation
IS	Rule of law; integrity; enforcement predictability	Regulatory quality; government effectiveness; business environment	Institutional conditions
IC	R&D intensity; innovation networks; collaboration	Patents; publications; high-tech employment	Innovation capacity
CM	Resource productivity; material/waste intensity; recycling	Circular material use; secondary materials; repair and environmental investment	Material outcomes
IEP	Export sophistication; diversification; capital connectedness	Economic complexity; GVC participation; domestic value added	External economic profile

Source: Developed by the author.

Following Table 1, core indicators define the comparative positioning of countries along each dimension, while validating indicators provide supplementary context. This structure ensures that cross-country comparisons remain consistent, transparent, and analytically meaningful, despite variation in data availability.

Building on the two-tier architecture, the framework defines *a baseline composite-index procedure* to summarize and compare indicators. Each indicator is aggregated into period-representative statistics, typically using means over the selected analytical window. Indicators are standardized using z-scores and harmonized in directionality, with pressure indicators sign-adjusted as needed. Composite scores are computed with equal weighting, producing dimension-specific results that preserve interpretive clarity without imposing artificial precision to support robustness, basic stability checks are included, such as alternative normalization methods, modest variations in weighting, and selective leave-one-out tests for multi-indicator dimensions. These checks assess sensitivity to methodological choices. (Nardo et al., 2005; OECD, 2008).

To demonstrate how the framework can be applied under constrained data conditions, Table 2 presents illustrative comparative profiles based on simple period averages (2021-2022) using a minimal set of core indicators. The results are intended for comparative illustration and are not fully standardized.

Table 2. Illustrative comparative profiles (selected indicators, 2021-2022 averages)

Country	Rule of Law (WGI)	R&D (% GDP)	Resource productivity (EUR/kg)	High-tech exports (% of manufactured goods)
Germany	84.64	3.13	2.7851	16.44
Bulgaria	55.79	0.76	0.343	10.65
Romania	64.69	0.465	0.364	11.68

Source: Developed by the author based on publicly available data from the World Bank and Eurostat databases.

Building on Table 1, Table 2 illustrates how core indicators can be summarized into dimension-specific scores, facilitating direct cross-country comparison even under limited data conditions. Germany exhibits consistently strong performance across all dimensions: high institutional quality, substantial R&D intensity, strong resource productivity, and a large share of high-tech exports. Bulgaria shows moderate institutional conditions and material outcomes but lower innovation capacity and external positioning, suggesting partial misalignment. Romania displays a mixed profile, with moderate institutional conditions and material outcomes, weaker innovation capacity, and intermediate external positioning.

While these patterns are illustrative rather than conclusive, they demonstrate the framework's utility in identifying alignment and divergence between internal structural profiles and external economic outcomes. The approach supports small-N comparative analysis by enabling structured, transparent, and level-consistent interpretation, even when data availability is uneven. Furthermore, the profiles highlight the potential for nuanced diagnostic insights: strong material outcomes without corresponding innovation capacity may indicate structural or policy gaps, while robust internal conditions with weaker external positioning could reflect barriers to translating domestic capacities into international economic advantages.

5. Conclusions

Building on the analytical outputs, this paper has proposed a comparative profile-analytical framework for examining the relationship between circular materialization and international economic positioning under conditions of uneven data availability and limited case numbers. The framework contributes a structured approach for organizing macro-level comparison through a parsimonious and transparent indicator logic.

The illustrative application demonstrates the framework's diagnostic value. Germany exhibits consistently strong internal and external alignment, Bulgaria shows partial correspondence between structural conditions and external positioning, while Romania presents a more mixed profile. These results are intended as illustrative rather than definitive, highlighting the framework's capacity to reveal comparative patterns under data constraints.

Overall, the study contributes a structured and extensible approach to macro-level comparative analysis of sustainability-related material outcomes and external economic structures. Future research may extend this framework through richer indicator sets, sectoral disaggregation, and integration with firm-level evidence to further explore multi-level dynamics.

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ASSESSMENT OF THE VULNERABILITY AND EXTERNAL ECONOMIC RESILIENCE OF THE REPUBLIC OF MOLDOVA IN RELATION TO REGIONAL GEOPOLITICAL RISKS AND THE TRANSFORMATIONS OF THE INTERNATIONAL TRADING SYSTEM

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Abstract: *The study assesses the vulnerability and external economic resilience of the Republic of Moldova in the context of increasing regional geopolitical risks and ongoing transformations of the international trading system. The analysis covers the period 2014–2024 and is based on official statistical data on exports, imports, and nominal gross domestic product. The research examines the dynamics of external trade flows, structural changes in the geographical orientation of exports, the level of trade openness, and the persistence of trade imbalances. In addition, a log-linear econometric model is estimated using the Ordinary Least Squares (OLS) method, which enables the evaluation of the relationship between exports, the size of the economy, and the share of exports directed toward the European Union market. The results indicate that the progressive reorientation of exports toward the European Union has contributed to strengthening external resilience. However, the persistent trade deficit and the high level of trade openness continue to maintain a significant degree of structural vulnerability. The contribution of the study lies in integrating the descriptive analysis of trade indicators with the econometric evaluation of the determinants of export performance, thereby providing a systemic perspective on the external economic position of the Republic of Moldova.*

Keywords: external vulnerability, economic resilience, trade openness, exports, Republic of Moldova.

Classification JEL: F14, F62, O11.

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1. Introduction

Over the last two decades, the international trading system has undergone profound transformations driven by globalization, digitalization, financial crises, pandemics, and geopolitical tensions.

Uncertainty associated with trade policies represents an important factor influencing the evolution of international trade and the behaviour of economic agents. Frequent changes in trade regulations, the possible introduction of tariffs or restrictions, and shifts in trade agreements can create an economic environment characterized by a high degree of unpredictability. Under such conditions, firms tend to exercise caution in investment decisions and in expanding export activities, while some trade flows may be postponed or redirected toward markets perceived as more stable. From this perspective, small and open economies are particularly sensitive to increasing trade policy uncertainty, as they depend to a significant extent on the stability of trade rules and on predictable access to external markets (Handley & Limão, 2022).

The UNCTAD Trade and Development Report highlights that the global economy is currently experiencing a period characterized by slowing economic growth, increasing financial uncertainty, and increasingly pronounced divergences among economies. In this context, many developing countries are becoming more vulnerable to fluctuations in the international economic environment, as they depend significantly on external trade flows, global financial conditions, and the stability of supply chains. Consequently, the volatility of international trade, pressures on external debt, and growing global economic fragmentation can amplify macroeconomic risks and limit the capacity of small and open economies to absorb external shocks (UNCTAD, 2023).

The increasing integration of national economies into the international trading system has led to a high degree of economic interdependence among states. Under these conditions, global economic shocks - such as financial crises, disruptions in supply chains, geopolitical conflicts, or volatility in trade flows - are rapidly transmitted across economies. Analyses conducted by international financial institutions highlight that external imbalances and instability in the global economic environment can significantly influence the evolution of international trade and macroeconomic stability, particularly affecting small and open economies that depend to a considerable extent on access to external markets (International Monetary Fund, 2022).

The Republic of Moldova represents a relevant case of an economy characterized by a high level of trade openness, a concentrated export structure, and a structural dependence on imports. The period 2014–2024 is particularly important for assessing external vulnerability, as it includes the reconfiguration of regional trade relations, the pandemic shock of 2020, and the geopolitical instability that intensified starting in 2022.

At the same time, the level of external vulnerability is closely linked to a country's economic competitiveness. The economic competitiveness of the Republic of Moldova is influenced by several structural factors, including the level of development of the entrepreneurial environment, the capacity for innovation, and the degree of integration into the international economy. In this context, the analysis of national competitiveness highlights the existence of several challenges related to relatively low productivity, the structure of exports, and the need to modernize economic infrastructure, factors that directly influence economic performance and the country's positioning within the global economy (Belostecinic, Guţu & Bragoi, 2020).

Innovation processes are strongly influenced by the degree of openness of an economy and by the level of its integration into the international economic system. Economies characterized by a high level of international trade create favourable conditions for the development of innovation and for the adoption of modern technologies, as firms are exposed to external competition and to the circulation of ideas, knowledge, and best practices. At the same time, trade flows, foreign investments, and technology imports contribute to facilitating technology transfer and to the modernization of production processes. Moreover, access to broader external markets provides enterprises with additional opportunities for economic growth, production diversification, and the strengthening of long-term competitiveness (Cassiman, Golovko & Martínez-Ros, 2010).

The purpose of this study is to analyse the vulnerability and external resilience of the economy of the Republic of Moldova in the context of recent geopolitical and economic transformations, by examining the evolution of foreign trade indicators and by estimating

the relationships between exports, the size of the economy, and the geographical orientation of trade flows.

In order to achieve this objective, the following research objectives were established: the analysis of the evolution of exports and imports of the Republic of Moldova during the analysed period; the evaluation of the degree of trade openness and of the trade deficit; the examination of the role of the European Union market in the dynamics of exports; and the estimation of an econometric model aimed at identifying the factors that influence the evolution of exports.

The paper is structured as follows: the next section reviews the relevant literature, followed by the methodology, results and discussion, and conclusions.

2. Literature Review

The issue of external economic vulnerability has been extensively analysed in the economic literature, particularly in the context of globalization and increasing geopolitical uncertainty. Recent studies emphasize that small and open economies are more exposed to external shocks due to their dependence on international trade flows and external markets (Handley & Limão, 2022).

At the same time, the concept of economic resilience has gained increasing attention, being associated with the ability of economies to absorb shocks and adapt to changing external conditions. According to international analyses, resilience is influenced by factors such as trade diversification, macroeconomic stability, and integration into stable economic areas (International Monetary Fund, 2022).

Other studies highlight that the geographical orientation of exports plays a key role in determining external stability. Economies that are highly concentrated on a limited number of markets tend to exhibit higher vulnerability, while diversification contributes to increased resilience (World Trade Organization, 2023).

While most studies emphasize the role of trade diversification in reducing vulnerability, there is no consensus regarding the extent to which geographical reorientation alone can ensure long-term resilience. Some authors argue that structural factors, such as domestic production capacity, play an equally important role.

In the case of the Republic of Moldova, the literature indicates both progress in the reorientation of exports toward the European Union and the persistence of structural imbalances, particularly in terms of trade deficits and dependence on imports (EU4Moldova, 2025).

Although the existing literature provides valuable insights into external vulnerability and economic resilience, most studies tend to analyse these concepts separately or focus on broader regional contexts. In addition, limited attention has been given to the combined assessment of vulnerability and resilience in small open economies exposed to recent geopolitical disruptions. Moreover, limited studies have simultaneously examined both external vulnerability and resilience in the context of recent geopolitical transformations. This highlights the need for a more integrated analytical approach.

In this context, the present study contributes to the literature by offering an integrated perspective that combines descriptive trade indicators with econometric analysis, focusing specifically on the Republic of Moldova during a period marked by significant structural and

geopolitical changes. The following section presents the methodological framework used to assess external vulnerability and resilience.

3. Methodology

The methodological framework is designed to evaluate external vulnerability through a combination of trade indicators and econometric analysis. The analysis aims to evaluate the external economic vulnerability and resilience of the Republic of Moldova through relevant trade and macroeconomic indicators. External vulnerability is examined from three perspectives: trade integration, the geographical structure of exports, and external imbalance.

The trade dimension is assessed through the degree of trade openness, determined as the ratio between the sum of exports and imports and nominal gross domestic product. The structural dimension is analysed through the share of exports directed to the European Union and to the Commonwealth of Independent States (CIS) countries in total exports, indicators that allow the assessment of the geographical orientation and the degree of concentration of external markets. The macroeconomic dimension is reflected through the trade deficit and its ratio to GDP.

The empirical analysis uses annual data for the period 2014-2024, provided by the National Bureau of Statistics. The variables included are total exports (FOB), total imports, exports to the European Union, exports to the CIS countries, and nominal GDP, expressed in current U.S. dollars.

To investigate the relationship between exports and macroeconomic factors, a logarithmic regression model was estimated, in which total exports represent the dependent variable, while nominal GDP and the share of exports directed to the European Union are the explanatory variables. The estimation was carried out using the Ordinary Least Squares (OLS) method, in order to identify structural relationships between the size of the economy, trade orientation, and export performance. To ensure a clearer interpretation of the economic relationships between the variables, the model uses the logarithmic transformation of the main macroeconomic variables. This approach allows the estimated coefficients to be interpreted in terms of elasticities and contributes to stabilizing the variance of the data, thereby reducing potential heteroscedasticity issues. The use of the Ordinary Least Squares (OLS) method facilitates the estimation of the relationships between the size of the economy, the geographical orientation of exports, and the performance of total exports.

This approach makes it possible to correlate the descriptive analysis of trade indicators with an econometric evaluation of the determinants of exports.

4. Results and Discussion

The period 2014-2024 provides a relevant framework for examining the evolution of the external position of the Republic of Moldova in a regional context characterized by instability and trade reconfigurations. The analysis of foreign trade indicators makes it possible to identify dominant trends, potential structural adjustments, and changes in the orientation of trade flows. The study highlights the main findings regarding the dynamics of exports and imports, as well as their implications for the external balance of the economy.

A more detailed examination of trade dynamics over the analysed period reveals significant fluctuations associated with both internal adjustments and external shocks. The evolution of exports and imports reflects not only changes in external demand but also structural characteristics of the domestic economy. In particular, the persistent gap between exports and imports suggests a structural imbalance that has remained relatively stable over time. These developments underline the importance of analysing trade flows not only in absolute terms, but also in relation to broader macroeconomic conditions.

In this context, Table 1 provides a comprehensive overview of the evolution of exports and imports, serving as a basis for assessing the magnitude and persistence of external imbalances.

Table 1. Evolution of Exports and Imports of the Republic of Moldova (2014–2024, thousand USD)

Year	Exports	Imports
2014	2.339.529,6	5.316.958,9
2015	1.966.837,2	3.986.820,3
2016	2.044.538,65	4.020.356,96
2017	2.424.972,03	4.831.335,29
2018	2.706.173,30	5.760.057,05
2019	2.779.164,47	5.842.484,34
2020	2.467.106,08	5.415.988,30
2021	3.144.504,54	7.176.761,19
2022	4.332.145,12	9.218.978,77
2023	4.048.604,91	8.675.450,34
2024	3.555.061,73	9.065.184,72

Source: Developed by the author based on data from the National Bureau of Statistics (Accessed on March 1, 2026, from https://statistica.gov.md/ro/statistic_indicator_details/19#data_bank)

The data presented in Table 1 provide a clear overview of the evolution of exports and imports during the analysed period, highlighting both the overall upward trend and the fluctuations associated with external economic shocks. These developments are further illustrated in Figure 1.

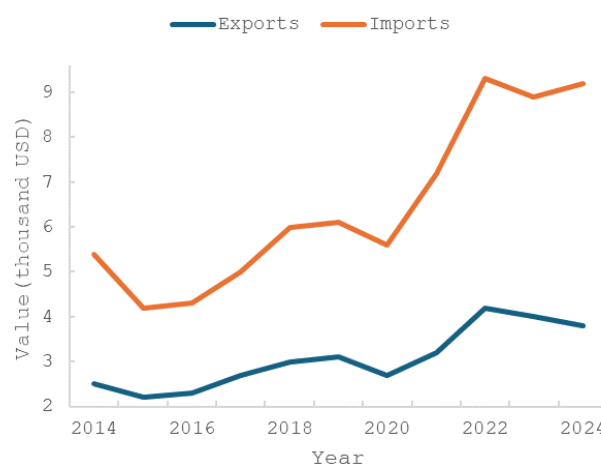


Figure 1. Evolution of Exports and Imports of the Republic of Moldova (2014–2024)

Source: Developed by the author based on data from the National Bureau of Statistics of the Republic of Moldova. Accessed on March 1, 2026, from <https://statistica.gov.md>

These findings are consistent with previous studies on small open economies, which emphasize that persistent trade imbalances reflect structural dependence on imports and limited domestic production capacity. At the same time, the results reinforce the view that exposure to external demand fluctuations increases macroeconomic vulnerability, particularly in economies with a narrow export base.

The evolution of exports and imports during the period 2014–2024 reflects the influence of both internal and external economic factors that affected trade dynamics differently from year to year. Throughout the analysed interval, exports ranged between approximately 1.97 billion USD (2015) and 4.33 billion USD (2022), while imports fluctuated between 3.99 billion USD (2015) and more than 9.21 billion USD (2022), indicating a pronounced dynamic of trade flows.

The decline recorded between 2014 and 2016 is visible in both exports and imports. Exports decreased from 2.34 billion USD in 2014 to 1.97 billion USD in 2015, while imports fell from 5.31 billion USD to 3.98 billion USD during the same period. This adjustment can be explained by the reconfiguration of trade relations and the reduction in demand on some traditional external markets, as the economy underwent a process of adaptation to the new regional conditions.

The period 2017–2019 marks a gradual recovery of trade flows. Exports increased steadily, reaching approximately 2.78 billion USD in 2019, while imports exceeded 5.84 billion USD in the same year. This development may be associated with expanded access to the European Union market and the consolidation of external trade relations. At the same time, the increase in imports reflects the growth of domestic consumption and the demand for intermediate and energy goods.

In 2020, a decline is observed in both components of foreign trade, with exports falling to 2.47 billion USD and imports to 5.41 billion USD. This development was mainly driven by the effects of the COVID-19 pandemic, which disrupted logistical chains and reduced external demand.

The years 2021 and 2022 highlight a significant increase, particularly in 2022, when exports reached 4.33 billion USD and imports exceeded 9.21 billion USD, representing the highest values recorded during the entire analysed period. This increase was influenced both by the post-pandemic economic recovery and by the rise in international prices for energy and agri-food products, which amplified the overall value of trade transactions.

In 2023 and 2024, a moderation in exports can be observed, declining to 4.05 billion USD in 2023 and 3.55 billion USD in 2024, while imports remained at a high level, exceeding 9 billion USD in 2024. This evolution suggests a slowdown in external demand and a continued dependence on imported goods, particularly energy resources and intermediate products.

Overall, the persistent gap between exports and imports - which in some periods exceeds 4-5 billion USD annually - highlights the structural nature of the trade deficit. The observed variations result from the interaction between external factors (regional crises, volatility in international prices, and changes in trade routes) and internal factors (production capacity, the structure of exports, and the level of domestic demand).

The results suggest that integration into global value chains may increase vulnerability. Furthermore, such integration also involves certain structural risks, as dependence on a limited number of suppliers or trading partners may increase the vulnerability of economies

to external shocks, global crises, or geopolitical tensions. Under these conditions, economic resilience depends not only on the level of trade integration but also on the diversification of economic relations and supply sources (World Trade Organization, 2023).

The asymmetric dynamics between exports and imports confirm the existence of a persistent imbalance, which is relevant for assessing the external vulnerability of the economy of the Republic of Moldova.

Beyond the overall dynamics of exports and imports, a deeper understanding of external vulnerability requires the analysis of the geographical distribution of trade flows. In this context, Table 2 presents the distribution of exports by major groups of countries, highlighting the changes in trade orientation during the analysed period.

Table 2. Structure of Exports by Groups of Countries (2014–2024, thousand USD)

Year	Exports to the European Union	Exports to the CIS
2014	1.245.980,0	735.647,7
2015	1.217.587,1	492.294,6
2016	1.331.898,45	414.185,25
2017	1.596.839,60	462.820,45
2018	1.861.863,96	415.922,25
2019	1.830.548,39	434.949,51
2020	1.640.367,53	376.962,60
2021	1.919.531,97	466.207,47
2022	2.537.508,51	1.043.042,14
2023	2.646.659,65	897.005,13
2024	2.392.368,77	241.596,18

Source: Developed by the author based on data from the National Bureau of Statistics (Accessed on March 1, 2026, from https://statistica.gov.md/ro/statistic_indicator_details/19#data_bank)

The share of exports to the European Union increased steadily, while exports to the CIS countries declined significantly. This reorientation indicates a strategic adaptation to the new geopolitical and economic realities. This pattern is in line with existing empirical research suggesting that the diversification and reorientation of exports toward more stable and economically integrated markets contribute to enhancing external resilience. At the same time, the findings confirm that reduced dependence on volatile markets can mitigate the transmission of external shocks.

The economic integration of the Republic of Moldova into the European economic space has been strengthened in recent years through a series of initiatives and agreements aimed at supporting economic development and convergence with European Union standards. Among these is the implementation of the European Union Growth Plan for the Republic of Moldova, which combines structural reforms, investments, and financial support to stimulate economic development, modernize infrastructure, and strengthen economic connections with the European market (EU4Moldova, 2025).

Deeper integration into the EU market has contributed to the stability of trade flows and to reducing dependence on markets characterized by high volatility.

In order to assess the level of integration of the Republic of Moldova's economy into international trade and to quantify its exposure to external fluctuations, the degree of trade openness was calculated for the period 2014-2024. This indicator reflects the ratio between the total volume of trade flows and nominal gross domestic product.

Economies characterized by a high degree of trade openness are more exposed to external economic fluctuations, as export dynamics depend not only on domestic production capacity but also on the evolution of demand in partner economies. Under such conditions, economic shocks affecting trade partners may generate indirect effects on export performance and on domestic macroeconomic stability (Eurostat, 2026).

Table 3. Degree of Trade Openness of the Republic of Moldova (2014–2024)

Year	Exports + Imports (thousand USD)	GDP (thousand USD)	Trade Openness (%)
2014	7.656.488,5	9.399.967	81,45
2015	5.953.657,5	7.798.648	76,34
2016	6.064.895,6	7.980.938	75,99
2017	7.256.307,3	9.518.976	76,23
2018	8.466.230,3	11.251.641	75,24
2019	8.621.648,8	11.735.722	73,47
2020	7.883.094,4	11.531.922	68,36
2021	10.321.265,7	13.690.980	75,39
2022	13.551.123,9	14.520.739	93,32
2023	12.724.055,3	16.714.886	76,12
2024	12.620.246,5	18.206.842	69,32

Source: Developed by the author based on data from the National Bureau of Statistics (Accessed on March 1, 2026, from https://statistica.gov.md/ro/statistic_indicator_details/19#data_bank)

The degree of trade openness was determined according to the following relationship:

$$\text{Trade Openness} = (\text{Exports} + \text{Imports}) / \text{GDP} \times 100\% \quad (1)$$

To ensure comparability, all variables were expressed in thousand U.S. dollars, using GDP values at current prices. The values presented in Table 3 indicate that the economy of the Republic of Moldova operated throughout the analysed period under conditions of high trade openness, with the average value of the indicator being around 77%. Such a level confirms the deep integration of the economy into the international trading system and its structural dependence on external flows of goods.

During the period 2014-2019, the degree of trade openness fluctuated moderately between 73% and 81%, reflecting a phase of consolidation of external trade relations, particularly following the deepening of economic ties with the European Union. During this period, the dynamics of exports and imports were broadly correlated with the evolution of GDP, without extreme imbalances in the trade-to-GDP ratio.

The significant decline recorded in 2020 (68.36%) can be explained by the impact of the COVID-19 pandemic on global trade flows. Logistical restrictions, disruptions in supply chains, and the reduction of external demand led to a decrease in the volume of trade relative to the size of the economy. This development demonstrated the direct sensitivity of the Moldovan economy to systemic external shocks.

The year 2022 represents a turning point. The degree of trade openness reached 93.32%, the highest level during the entire analysed period. This increase reflects not only an expansion of exports but also a strong intensification of imports in a regional context marked by geopolitical instability and the reconfiguration of trade routes. The high volume of trade relative to GDP indicates a significant external exposure, as the economy became strongly connected to the dynamics of international trade flows. Under conditions of regional instability, such a level may amplify both temporary trade opportunities and risks associated with external volatility.

These results confirm the conclusions of international studies, which argue that economies characterized by high levels of trade openness benefit from increased integration into global markets, but at the same time face higher exposure to external economic fluctuations. In this context, the literature underlines that openness represents both a source of growth and a channel through which external shocks are transmitted.

In 2023 and 2024, a downward adjustment of the indicator can be observed, reaching 69.32% in 2024. This evolution suggests a relative normalization of the relationship between trade and GDP, supported by the partial stabilization of trade flows and the growth of nominal GDP. The decline of the indicator does not imply a withdrawal from international trade, but rather a rebalancing between the size of the economy and the volume of trade exchanges. The evolution of the degree of trade openness over the analysed period is presented in Figure 2.

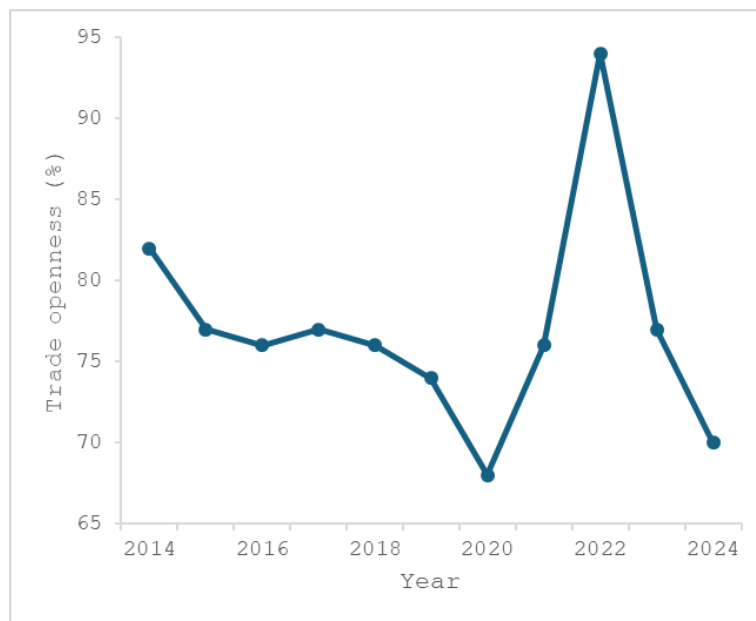


Figure 2. Trade Openness of the Republic of Moldova (2014-2024)

Source: Developed by the author based on data from the National Bureau of Statistics of the Republic of Moldova. Accessed on March 1, 2026, from <https://statistica.gov.md>

The degree of trade openness presented in Figure 2 highlights the high level of integration of the economy of the Republic of Moldova into international trade. Throughout the analysed period, the indicator recorded significant fluctuations, yet its values remained consistently at a high level. This evolution reflects the dependence of the national economy on external trade flows and its sensitivity to changes in the international economic environment. The sharp increase observed in 2022 indicates an intensification of trade exchanges within a regional context marked by geopolitical instability and economic volatility, while the subsequent decline suggests a gradual adjustment in the relationship between trade and the size of the economy.

Overall, the high level and volatility of the indicator confirm the dual nature of trade openness. On the one hand, external integration facilitates access to markets, the diversification of exports, and the attraction of resources. On the other hand, this integration enables the rapid transmission of external shocks into the domestic economy, amplifying vulnerability during periods of global or regional crisis. Although this indicator is not directly included in the estimated econometric model, it provides a relevant context for

interpreting the evolution of exports and for understanding the degree of integration of the national economy into the international trading system.

At the same time, the analysis of the degree of trade openness provides a useful framework for assessing the external vulnerability of the economy. A high level of this indicator suggests that the evolution of economic activity is significantly influenced by the dynamics of external markets and by the performance of trading partners. Under such conditions, fluctuations in the international economic environment may have direct effects on macroeconomic stability and on export performance.

For a more in-depth assessment of external vulnerability, it is necessary to analyse the trade imbalance in relation to the size of the economy. In this regard, the trade deficit and its share in GDP were calculated for the period 2014–2024.

Table 4. Trade Deficit and Its Share in GDP (2014–2024)

Year	Trade Deficit (thousand USD)	GDP (thousand USD)	Deficit / GDP (%)
2014	2.977.429,3	9.399.967	31,67
2015	2.019.983,1	7.798.648	25,90
2016	1.975.818,3	7.980.938	24,75
2017	2.406.363,3	9.518.976	25,28
2018	3.053.883,8	11.251.641	27,14
2019	3.063.319,9	11.735.722	26,10
2020	2.948.882,2	11.531.922	25,57
2021	4.032.256,6	13.690.980	29,45
2022	4.886.833,6	14.520.739	33,65
2023	4.626.845,4	16.714.886	27,68
2024	5.510.122,9	18.206.842	30,27

Source: Developed by the author based on data from the National Bureau of Statistics (Accessed on March 1, 2026, from https://statistica.gov.md/ro/statistic_indicator_details/19#data_bank)

The trade deficit was calculated as the difference between imports and exports, while its share in GDP was determined according to the following relationship:

$$\text{Trade Deficit} = \text{Imports} - \text{Exports} \quad (2)$$

$$\text{Deficit / GDP} = (\text{Trade Deficit} / \text{GDP}) \times 100 \quad (3)$$

The data presented in Table 4 highlight the structural nature of the trade imbalance of the Republic of Moldova. Throughout the entire analysed period, the trade deficit remained at relatively high levels, varying between approximately 25% and over 33% of GDP.

The years 2014, 2022, and 2024 stand out due to particularly high levels of the deficit relative to GDP, exceeding the 30% threshold. Such a level reflects significant pressure on the macroeconomic balance and indicates an increased dependence on external financing.

In 2022, when the deficit reached 33.65% of GDP, the economy simultaneously faced rising imports and heightened regional volatility. This combination suggests an amplification of external vulnerability within an uncertain geopolitical context.

The persistence of the deficit at high levels confirms that, although exports have increased and the orientation toward the European Union has strengthened, the domestic economic structure does not yet generate sufficient resources to balance trade flows.

Persistent trade imbalances are considered an indicator of external vulnerability, as dependence on imports and the need to finance the deficit may increase the sensitivity of the

economy to external shocks and to changes in international trade conditions (Eaton & Kortum, 2002).

Relating the trade deficit to GDP complements the analysis of the degree of trade openness and provides a clearer picture of external vulnerability. While trade openness reflects the level of integration, the trade deficit expresses the sustainability of this integration. In the case of the Republic of Moldova, external integration is high, yet the persistent trade imbalance indicates the existence of structural vulnerabilities that may amplify the effects of regional geopolitical shocks.

In order to assess the factors influencing export performance, a simplified econometric model was estimated, in which total exports are explained by the size of the economy and the geographical orientation of exports.

The model has the following form:

$$\ln(\text{EXP}_t) = \alpha + \beta_1 \ln(\text{GDP}_t) + \beta_2 \text{SH\_UE}_t + \varepsilon_t(4)$$

where:

- EXP_t – represents the value of total exports in year t (thousand USD);
- α – represents the intercept of the model;
- β_1 and β_2 – represent the regression coefficients;
- GDP_t – represents the nominal gross domestic product in year t (thousand USD);
- SH_UE_t – represents the share of exports directed to the European Union in total exports;
- ε_t – represents the error term, capturing the influence of other factors not explicitly included in the model.

The model is based on two fundamental economic hypotheses. First, the size of the economy influences export capacity, as a larger economy (measured by GDP) has more developed productive capacities, better infrastructure, and a broader industrial base, which supports the growth of exports. Second, the geographical orientation of exports may influence their stability, and deeper integration into the European Union market can contribute to stabilizing trade flows due to access to a large and relatively predictable market.

Table 5. OLS Estimation Results for the Export Determinants Model (2014–2024)

Variable	Coefficient	t-statistic	Probability
Constant	-1,84	-2,21	0,058
$\ln(\text{GDP})$	0,91	8,12	0,000
SH UE	0,29	2,44	0,041

Source: Developed by the author based on data from the National Bureau of Statistics (Accessed on March 1, 2026, from <https://statistica.gov.md/ro/>)

The model yields $R^2 = 0.88$ and Adjusted $R^2 = 0.85$, indicating that approximately 88% of the variation in exports is explained by the included variables.

The model is estimated based on an annual series covering the period 2014–2024, an interval that includes distinct economic stages and relevant episodes of structural adjustment. Although the analysis uses a limited number of observations, the selected period allows the essential relationships between exports, the size of the economy, and the geographical orientation of trade flows to be captured. Within this framework, the results provide a

coherent perspective on the structural trends that have characterized the economy of the Republic of Moldova in the context of recent trade transformations.

The coefficient β_1 associated with the variable $\ln(\text{GDP})$ is 0.91 and is statistically significant at the 1% level. This means that a 1% increase in GDP is associated, on average, with an increase of approximately 0.9% in exports. This result confirms that export dynamics are closely correlated with the evolution of domestic productive capacity.

The results should be interpreted with caution, as the model does not include all structural factors that may influence export performance, such as institutional quality, human capital, or macroeconomic stability. In econometric analyses of economic growth, the omission of such relevant variables may lead to biased estimated coefficients and to the overestimation or underestimation of relationships between macroeconomic indicators. The inclusion of additional explanatory variables contributes to reducing this type of bias and to obtaining more robust estimates of economic relationships (Barro, 2003).

The coefficient β_2 , associated with the share of exports directed to the European Union, is positive (0.29) and statistically significant at the 5% level. This result indicates that an increase in the orientation toward the European Union market contributes to the growth of total exports. From a structural perspective, European integration appears as a factor strengthening external performance.

The results of the econometric model highlight the existence of a positive relationship between the size of the economy and export performance. At the same time, the positive coefficient associated with the share of exports directed to the European Union indicates that orientation toward this market contributes to stabilizing trade flows and strengthening the external performance of the economy of the Republic of Moldova.

The estimated relationships are broadly consistent with previous empirical research, which highlights that export performance in small open economies is closely linked to both economic size and access to stable external markets. In particular, the positive role of the European Union market supports the view that deeper economic integration contributes to improving export capacity and enhancing external resilience.

From a policy perspective, these findings suggest that strengthening the export capacity of the Republic of Moldova requires a coordinated approach targeting both the supply side and the institutional framework. Specifically, policies aimed at increasing the value added of domestic production, reducing administrative barriers to trade, and supporting the integration of local firms into European value chains could contribute to improving export performance. At the same time, given the persistent trade deficit, measures to stimulate import substitution in strategic sectors - particularly energy and intermediate goods - remain relevant for reducing external vulnerability over the medium term.

Based on the empirical results, the analysis suggests that strengthening economic resilience requires a combination of trade diversification, increased value-added exports, and improved integration into stable external markets.

In this context, the European Union represents a key anchor for external stability, while reducing dependence on volatile markets remains a strategic priority.

5. Conclusions

The analysis covering the period 2014–2024 highlights several key structural features of the Republic of Moldova's economy in the context of the evolving international trading environment. The consistently high level of trade openness reflects a strong integration into external markets, while the persistence of the trade deficit points to a structural mismatch between domestic production and import needs. At the same time, the gradual reorientation of exports toward the European Union stands out as one of the most important economic shifts of the past decade.

From a strategic standpoint, closer trade relations with the European Union contribute to greater external stability by ensuring access to a large and relatively predictable market. However, this positive trend is accompanied by continued reliance on imports, particularly in sensitive areas such as energy and intermediate goods, which sustains a notable level of external vulnerability.

The findings indicate that improving economic resilience requires a balanced set of measures focused on diversifying the production base, increasing the value added of exports, and supporting sectors with the potential to integrate into regional value chains. At the same time, investments in infrastructure, digital technologies, and renewable energy, together with the development of human capital and innovation capacity, are essential for strengthening the economy's ability to adjust to external shocks over the long term.

Overall, the results suggest that while international trade integration creates opportunities for economic development, it also exposes the economy to external risks. In this context, enhancing competitiveness and addressing structural imbalances remain critical for achieving sustainable economic growth.

The study has certain limitations, primarily related to the relatively small dataset and the simplified structure of the econometric model. Future research could expand the analysis by including additional variables and extending the time horizon, in order to obtain a more comprehensive understanding of external vulnerability and economic resilience.

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CYBER-ENABLED FRAUD AND MONEY LAUNDERING: CURRENT TRENDS AND THREATS

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Abstract: *Cyber-enabled fraud represent illegal activities by which fraudsters use digital tools such as online platforms, internet, e-mail, mobile telephony to obtain sensitive data, money or access to different systems. The money obtained from fraud are laundered via different channels. In this article are analyzed the current trends of cyber-enabled fraud, the ways how the money obtained from fraud are laundered and how to protect the customers in order not to become victims of fraudulent activity. The author analyzes the most frequent types of fraud: phishing, social engineering, card frauds, online transactions frauds, crypto investments scams, online shopping fraud and preventive measures necessary to be applied by financial institutions to protect their customers. In the article are highlighted the role of developing robust internal controls combined with educational programs for customers to prevent cyber enabled frauds.*

Keywords: *Anti-Money Laundering, cyber-enabled fraud, digital world, threats, security.*

Classification JEL: *K42, G18, M42.*

UDC: 343.37:004.056 **DOI:** <https://doi.org/10.53486/ser2026.27>

1. Introduction

We live in a world of digitalization. Digitalization contributed substantially to the economic development, but in the same time opened the door to new typologies of fraud, money laundering, financial crimes using advanced technologies.

Cyber-enabled fraud is evolving rapidly being registered more and more victims all around the world. Fraudsters are using automated techniques to commit fraud (bots, deepfake, phishing, etc.)

In this scientific article is analyzed the problem of increasing cyber-enabled frauds and the ways of preventing and combatting them. The main objective of the research is to analyze the current trends of cyber-enabled frauds and threats in order to develop a modern framework of anti-fraud measures and instruments to reduce the risks associated with the digital financial criminality.

The scientific novelty and originality of the scientific paper consists in identification and description of new typologies of fraud in the context of digitalization; presenting new ways of money laundering from cyber enabled fraud; formulating ways of preventing and combatting cyber-enabled frauds.

2. Literature Review

In the academic literature fraud is analyzed very extensively. Exist various researches on fraud from different perspectives: economical, legal, psychological, sociological and technical. The classic literature in the field of fraud (Cressey, 1953; Wells, 2017; Albrecht, 2018) focus more on psychological and organizational mechanisms which generate

fraudulent behavior, being introduced the models such as “fraud triangle”; rationalization theory and occupational frauds.

On the other hand, in modern literature (Goodman, 2015; Holt & Bossler, 2020; Yar, 2020; Casey, 2019; Mitnick, 2002) the analysis of fraud is more and more focused on digital fraud, emphasizing the role of digitalization, globalization and advanced technologies in creation of new typologies, new opportunities of crimes and new detection challenges.

In classic literature the researches were focused mostly on the following typologies of frauds:

- Accounting Fraud;
- Financial Misappropriation;
- Forgery and Deception;
- Occupational and Corporate Fraud.

These frauds are produced mostly manual and local. In modern literature frauds are automated, scalable, cross-border, the researches being focused on the following types of fraud:

- Cyber-enabled fraud;
- Digital identity fraud;
- Crypto / blockchain fraud;
- Phishing, malware, ransomware fraud;
- AI fraud (deepfake, voice cloning);
- FinTech platform fraud.

Goodman, M. (2015) in the book “Future crimes: Inside the digital underground and the battle for our connected world” analyzes cyber enabled fraud according to which digital fraud uses technology to deceive. Mitnick, K. D., & Simon, W. L. (2002) in the book “The art of deception: Controlling the human element of security” reveals that digital fraud exploits psychological manipulation. Glenny, M. (2011) in the book “DarkMarket: Cyberthieves, cybercops and you” analyzes the online fraud committed in the Internet.

Schneier, B. (2012) in the book “Liars and outliers: Enabling the trust that society needs to thrive” highlights that digital fraud exploits technical vulnerabilities. According to Krebs, B (2014), Holt, T.&Bossler, A. (2020), Yar, M. (2018) and Casey, E. (2019) fraud is using phishing, malware and data theft, where technology plays the central role.

From the literature on fraud which was analyzed we can conclude that nowadays more and more fraudsters activate via digital channels through Internet and technology compared to classic fraud which was more manual and local.

The digitalization of economy created opportunities for the development of cyber-enabled fraud which represent a threat to the financial system stability, business and corporate integrity and individual security, being necessary steps to prevent and combat this increasing phenomenon.

3. Methodology

The scientific investigation is based on the data from the General Police Inspectorate, National Bank of Moldova, INTERPOL, FATF. The analysis covers the period 2023-2025 and focuses on the dynamics of cyber-enabled fraud cases, the value of losses, regional comparisons and the Global Fraud Index.

The research focuses on several key analytical dimensions, including:

- the dynamics of cyber-enabled fraud cases,
- the total and average value of financial losses,
- regional and international comparisons, and
- positioning within the Global Fraud Index, which reflects the relative exposure and vulnerability of countries to fraud-related risks.

To achieve the research objectives, a combination of **quantitative and qualitative methods** has been applied.

Time Series Analysis

The time series method is employed to examine the evolution of cyber-enabled fraud indicators over the 2023–2025 period. This approach allows for the identification of trends, fluctuations, and patterns in the number of reported cases and associated financial losses. Through this method, it becomes possible to detect growth rates, seasonal variations, and potential anomalies, thereby providing a dynamic perspective on the phenomenon under study.

Graphical Method

The graphical method is used to visually represent statistical data through charts, diagrams, and comparative figures. This facilitates a clearer interpretation of complex datasets and enhances the ability to identify relationships between variables such as time, geographical distribution, and financial impact. Visual representations support both descriptive and comparative analysis and contribute to increased transparency of the research findings.

Analysis and Synthesis

The method of analysis involves the decomposition of the studied phenomenon into its constituent elements, such as types of fraud schemes, categories of victims, and channels of execution (e.g., phishing, social engineering, online payment fraud). Conversely, synthesis integrates these elements into a coherent framework, allowing for the formulation of generalized conclusions regarding the structure and mechanisms of cyber-enabled fraud.

Induction and Deduction

Inductive reasoning is applied to derive general conclusions based on empirical observations and statistical data, particularly in identifying emerging trends and risk factors associated with cyber fraud. Deductive reasoning, on the other hand, is used to test existing theoretical assumptions and frameworks against the observed data, ensuring the logical consistency and validity of the findings.

The integration of these methods ensures a multidimensional approach to the study of cyber-enabled fraud. By combining statistical analysis with logical reasoning and visual interpretation,

the research provides both descriptive insights and explanatory value, contributing to a deeper understanding of the phenomenon from both national and global perspectives.

4. Results and Discussion

More frequently people become victims of cyber-enabled fraud, which can be committed by:

- Employees within the organization;
- Management or leadership;
- Customers or suppliers;
- Organized groups or external criminals;
- Corrupt professionals (auditors, accountants, consultants).

According to the 6th Anti-Money Laundering Directive (6AMLD) fraud is one of 22 predicate offences of money laundering (fig.1).

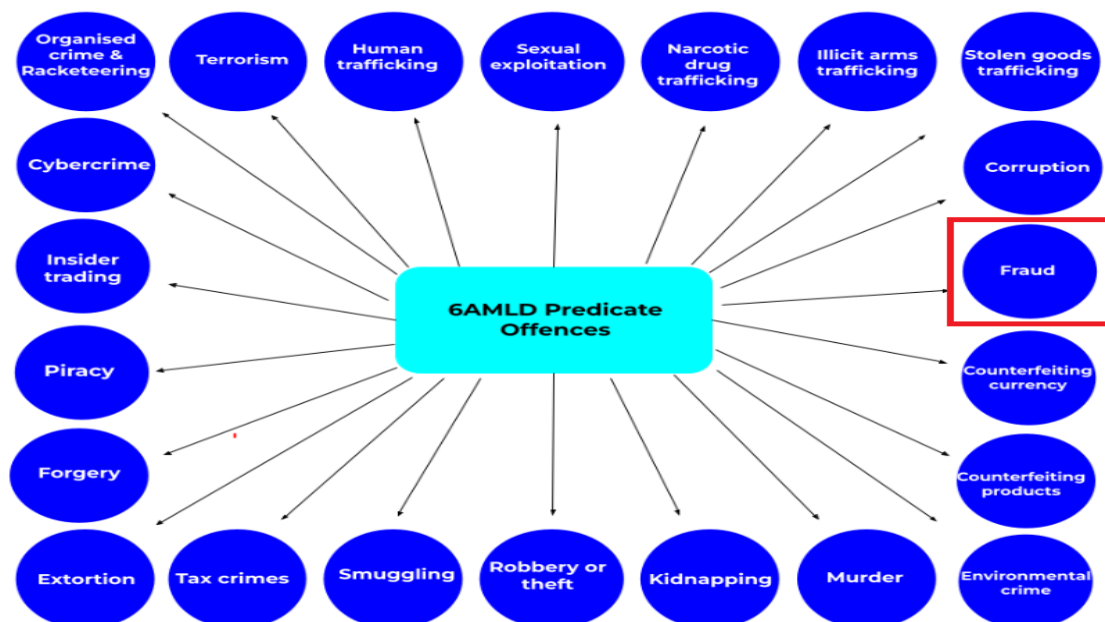


Figure 1. FRAUD – One of the 22 predicate offenses of ML according to 6 AMLD

Source: <https://www.tookitaki.com/compliance-hub/6aml-d-predicate-offences>

What is behind fraud? The Fraud Triangle

According to Donald R. Cressey, the fraud risk materializes when all 3 elements of fraud (fig.2):

Pressure + Opportunity + Rationalization are combined (1)

Pressure or motivation, as well as rationalization, are rather psychological factors that push the fraudster or create the temptation to commit fraud and the ability to explain to himself that what he is doing is right.



Figure 2. The Fraud Triangle

Source: <https://fitmallbusiness.com/what-is-the-fraud-triangle/>

Opportunity refers to access to assets or finances, combined with the lack of or weak controls that allow a fraudster to commit fraud and remain undetected.

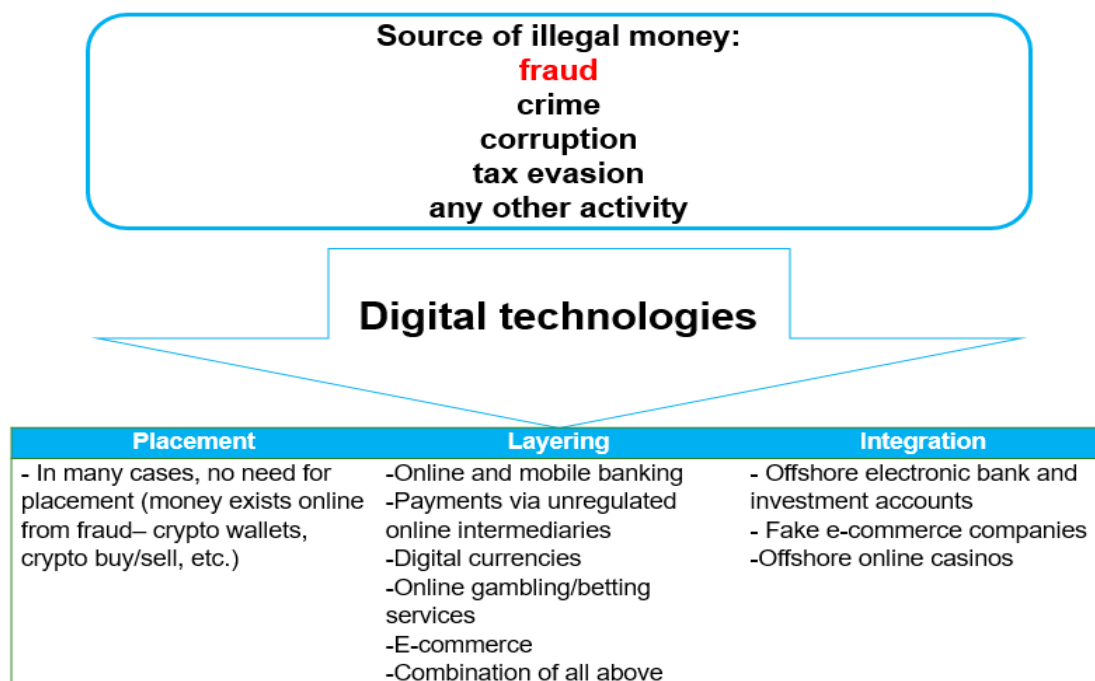


Figure 3. Digital technologies and illegal money transfers

Source: *elaborated by the author*

In fig. 3 is revealed how money from fraud are laundered via digital technologies using 3 stages of money laundering:

1. **Placement** – in many cases, no need for placement, the money exists online from fraud – crypto wallets, crypto buy/sell transactions

2. **Layering** – online and mobile banking, digital currencies, online gambling/betting services, E-commerce, combination of all above
3. **Integration** – offshore electronic bank and investment accounts, fake e-commerce accounts, offshore online casinos, etc.



Figure 4. Financial Fraud among the TOP 5 Global Crime Threats

Source: INTERPOL (2026)

According to INTERPOL (2026) financial fraud is among top 5 global crime threats after: cocaine trafficking, synthetic drugs trafficking, heroin trafficking, money laundering (fig.4).

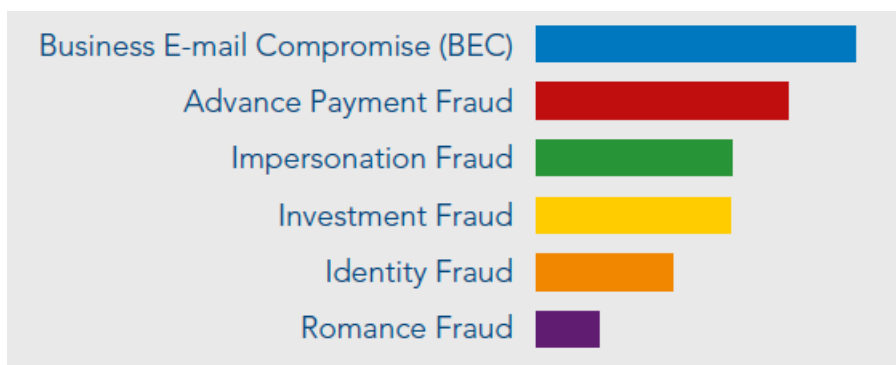


Figure 5. Top Global Financial Fraud Threats Facing Law Enforcement in 2024 and 2025

Source: INTERPOL (2026)

In fig.5 are presented the most frequent financial fraud registered in 2024 and 2025:

1. Business E-mail Compromise (BEC);
2. Advance Payment Fraud;
3. Impersonation Fraud;
4. Investment Fraud;
5. Identity Fraud;
6. Romance Fraud.

According to World Economic Forum (WEF, 2025), more than 77% of business leaders reported an increase of the frauds in 2025.

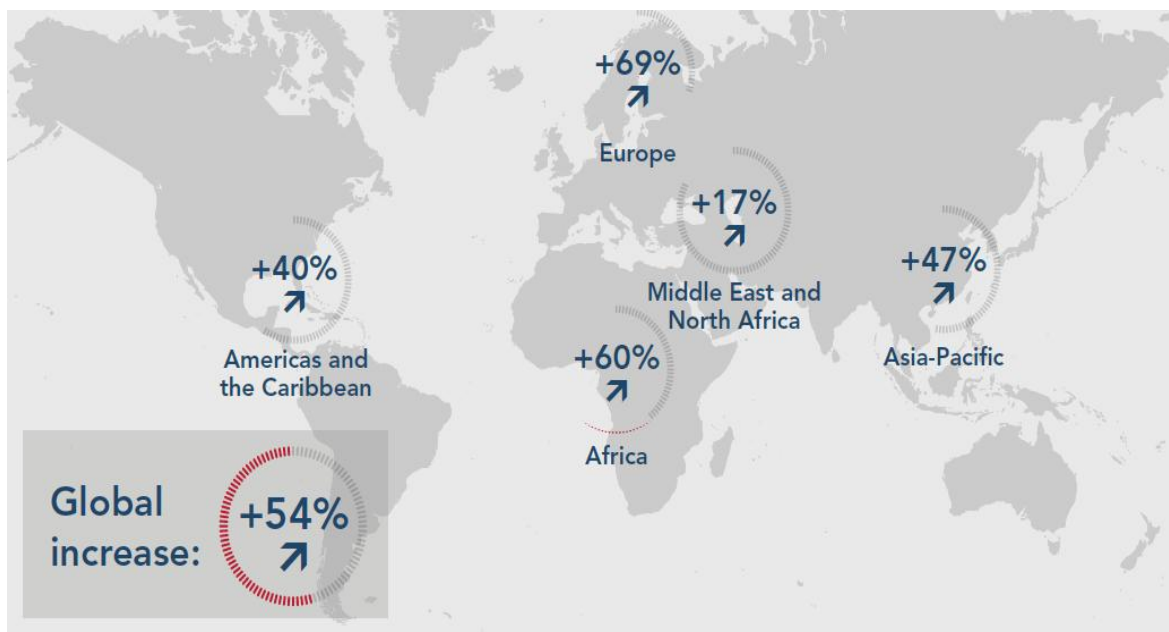


Figure 6. Global increase in financial fraud 2025 vs 2024

Source: INTERPOL (2026)

Analyzing the figure 6 we can reveal that in 2025 was registered a global increase in financial fraud by 54% compared to 2024. In regional context, mostly fraud increased in Europe: + 69%, being followed by Africa: +60%, Asia-Pacific: +47%, Americas ad the Caribbean +40%.

According to the Financial Action Task Force (FATF, 2025) report: “*Cyber-enabled fraud - Digitalisation and Money Laundering, Terrorist Financing and Proliferation Financing Risks*” in 156 jurisdictions or 90% of the jurisdictions assessed was identified fraud as a major money laundering risk. The rate of fraud is increasing all over the world – for example in Singapore, the number of cyber fraud cases has increased by 61% in two years.

In the United Kingdom, fraud now accounts for over 40% of all crime. Several countries estimate that up to 15% of their adult population has fallen victim to a successful cyber fraud attempt, underscoring the widespread and growing nature of this threat.

At the global level is calculated the Global Fraud Index (GFI), which evaluated 112 countries based on four weighted pillars to provide a comprehensive overview of fraud risk and how prepared each country is to access the necessary KYC/AML services (The Sumsuber, 2025):

1. **Fraud Activity (50%)** measures the severity of fraudulent activity, factoring in fraud networks, and AML rates.
2. **Resource Accessibility (20%)** reflects access to digital services and financial power, using indicators like GDP per capita, internet speed, and purchasing power.
3. **Government Intervention (20%)** evaluates regulatory anti-fraud commitment, infrastructure, and resilience through seven governance and policy metrics.
4. **Economic Health (10%)** tracks factors in instability such as corruption, cost of living, unemployment, and economic decline, which may rationalize fraudulent behavior.

Table 1. Global Fraud Index in regional context for 2025

Country	Global Fraud Index	Fraud Activity	Resource Accessibility	Government Intervention	Economic Health	Rank
 Moldova	× 2.53 ↓	0.57 ↓	1.58 ↑	0.74 ↑	0.49	59
 Romania	× 2.69 ↓	1.08 ↑	1.21 ↑	0.57 ↑	0.46	65
 Ukraine	× 3.71 ↓	1.62 ↓	1.63 ↑	0.78 ↑	0.53 ↓	89
Global Average	2.79	2.07	1.38	0.65	0.46	

Source: The Sumsuber (2025)

In regional context, Global Fraud Index for Moldova in 2025 was equal to 2.53, which compared to the neighbors - Romania and Ukraine is lower, where this indicator constituted: for Romania – 2.69 and for Ukraine – 3.71. In 2025, in Moldova was registered an increase by 0.05 compared to 2024 of government intervention, being equal to 0.74 (see table 1).

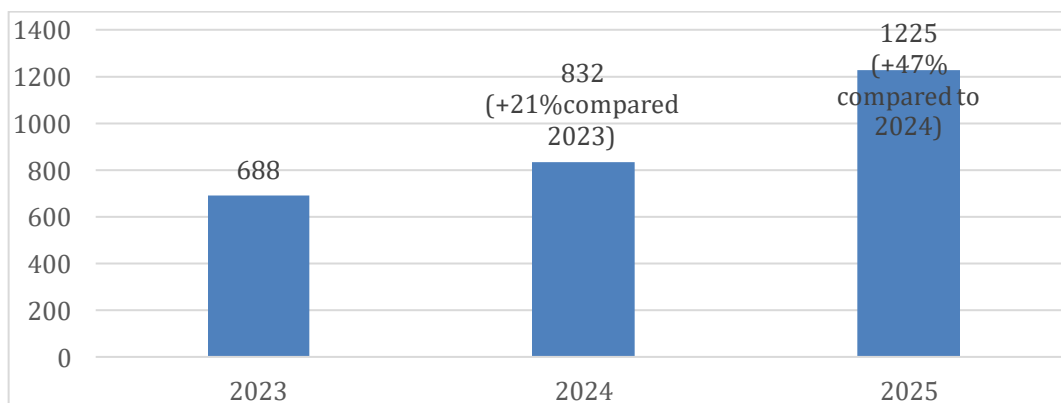
Table 2. Global Fraud Index in regional context for 2024

Country	GLOBAL INDEX	FRAUD INTENSITY	RESOURCE ACCESSIBILITY	GOVERNMENT INTERVENTION	ECONOMIC HEALTH
 Moldova	× 3.33	0.59	1.56	0.69	0.49
 Romania	× 3.23	1.04	1.19	0.54	0.46
 Ukraine	× 4.82	1.94	1.58	0.72	0.58
Global Average	3.32	0.77	1.32	0.68	0.45

Source: The Sumsuber (2025)

In the Report on police activity for 2025 (General Police Inspectorate, 2026) the total number of fraud cases increased by 16.62% in 2025 compared to 2024, being registered 3345 cases. The National Bank of Moldova (2026) published on the official website that cyber-enabled fraud have an increasing trend and recommended practical actions how to prevent and protect against fraud.

According to figure 7, there is an increasing trend of cyber-enabled fraud in 2025 compared to 2024, being registered 1225 cases (+47% compared to 2024).

**Figure 7. Dynamics of cyber-enabled fraud cases registered in Moldova 2023 -2025**

Source: elaborated by the author

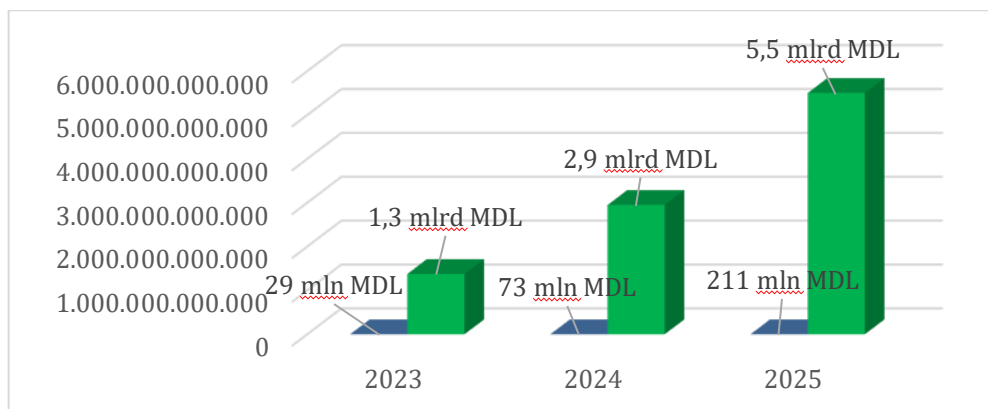


Figure 8. Value dynamics of cyber-enabled fraud in Moldova vs Europe 2023 -2025

Source: elaborated by the author

Analyzing the value dynamics of cyber-enabled fraud in Moldova vs Europe presented in fig.8 we can reveal that in 2025 the value of frauds constituted 211 mln MDL, which is more than in 2024 by 138 mln MDL, and by 182 mln MDL compared to 2023. The cyber-enabled fraud is evolving rapidly being necessary urgent measures from the state authorities, reporting entities (banks, microfinance organizations, etc.) in order to prevent and combat fraud.

How to protect yourself from electronic fraud?

1. Never transmit personal account information: password, CVV code, card expiration date or other sensitive information;
2. Read your monthly statements promptly and carefully. Contact your bank or other financial institution immediately if you identify unauthorized transactions or errors;
3. Never tell anyone your Online Banking password, not even to bank representatives. When you have completed your online banking session, log out and close the browser window. If you suspect fraud or suspicious activity, notify your bank immediately.
4. Choose a "strong" password that is not easily guessed. Try to have at least eight characters in your password, including letters, numbers, and symbols, such as the exclamation mark or pound sign. Change your password regularly.
5. Make sure you know and trust the merchant/vendor before disclosing any information regarding your payment account or pre-authorization of your account, etc.

5. Conclusions

1. In Moldova, cyber-enabled frauds recorded an increasing trend in 2025 compared to 2024 by 47%, with 1225 cases recorded;
2. The Global Fraud Index for Moldova registered a decreasing trend in 2025 compared to 2024 from 3.33 to 2.53 due to government intervention which increased in 2025 compared to 2024 from 0.69 to 0.74.
3. The most common cyber-enabled frauds are related to: fake investment platforms, the use of money mules/droppers; shopping fraud.

4. To protect ourselves from cyber-enabled frauds, it is necessary not to transmit personal account data or other sensitive banking information to unknown persons and not to access unknown links.
5. For financial institutions it is very important in preventing and combatting cyber-enabled fraud to:
 - to digitize control processes
 - to organize continuous Anti-Fraud & AML training with the employees
 - to organize customer information campaigns

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STRATEGIC MANAGEMENT FOR CIRCULAR ECONOMY: THE CASE STUDY OF TAILINGS POND NO. 1, HARGHITA-BĂI, ROMÂNIA

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Abstract: Mining activities generated large quantities of waste material stored in tailings ponds. In many regions, these sites represent environmental risks for ecosystems and nearby communities, while their management is usually limited to minimal maintenance and monitoring. In the context of the transition toward a circular economy and the growing importance of ESG (Environmental, Social and Governance) policies, these sites can also be reconsidered as potential economic resources. This paper analyse how strategic management tools can help identify sustainable solutions for the reuse of materials stored in tailings ponds. The research is based on an exploratory case study conducted on tailings pond no. 1 in Harghita Băi, Romania. The methodology used includes the analysis of the strategic environment through the application of the STEPLE and SWOT tools, in order to evaluate the factors that influence the management of the site. The results show that the pond contains approximately 2.5–3 million tonnes of kaolin sand and approximately 100,000 tonnes of kaolin, deposited over an area of approximately 16–17 hectares. Kaolin can be used for the development of cosmetic products and spa treatments, but also in agriculture, in the form of products with a photoprotective role for plants. Kaolin sand can be reused in the construction materials industry, including for obtaining cement materials or ceramic products. The conclusions of the study show that strategic management tolls, combined with circular economy principles such as resource recovery and waste reduction, can transform abandoned mining sites from environmental risks into opportunities for sustainable economic development.

Keywords: strategic management, sustainability, ESG, circular economy, tailings pods.

Classification JEL: Q56, Q57, L21.

UDC: 005.21:504.062.4:628.3(498) **DOI:** <https://doi.org/10.53486/ser2026.28>

1. Introduction

Mining played an important role during the global industrialization period. For Romania, mining represented one of the main sectors through which the communist regime experienced a phase of expansion during the period of accelerated industrialization, with most mining sites being opened at that time. The opening of these mining exploitation perimeters generated significant transformations affecting the environment, local communities, and especially the economy. In most mining exploitation perimeters, the deposit does not represent 100% the valuable mineral, as it is found in association with other types of materials, in different proportions from one case to another. Thus, in numerous situations, a part of the extracted material is considered waste or residue. This material requires storage, and the practice used over time in mining activities has been the construction of tailings ponds. These ponds are designed for waste storage and to withstand climatic and structural conditions. However, many of these sites are large in both height and

volume and are located near local communities. This is also the case of Tailings Pond No. 1 in Harghita Băi, Harghita, Romania. For over 50 years, this site has been closed and is considered to be an environmental problem. Management practices, in this case, have been limited to carrying out minimal maintenance works.

In many cases, the management of these sites falls to the state, turning them into a financial burden due to annual maintenance, monitoring, and consolidation requirements. The lack of intervention or the inadequate management of these residues can endanger the environment, local communities, and the economy as a whole. In this context, the need arises to analyze tailings ponds from the perspective of ESG (Environmental, Social and Governance) policies. Due to the major risks, the issue of tailings ponds must be effectively addressed through the application of strategic management.

Current research on this phenomenon focuses mainly on technological solutions and industrial processes for the recovery of materials from mining residues, as well as on their impact on the environment. In contrast, the managerial and strategic dimension of the valorization of these sites is analyzed to a lesser extent.

Thus, by integrating the principles of the circular economy into a strategic management strategy, the environmental risks of mining sites can be transformed into valorization opportunities. In this context, the following research question arises: „*What is the optimal solution, from the perspective of strategic management, to minimize the risks generated by these sites and, at the same time, to valorize the opportunities offered by the principles of the circular economy?*”.

The aim of the study is to highlight how strategic management can be used as a tool for integrating the principles of the circular economy into the management of mining sites with risk potential. The main objective of the research is to analyze, through a case study on Tailings Pond No. 1 in Harghita Băi, how the application of strategic management tools can contribute to the identification of directions for the valorization of residual materials in accordance with the principles of the circular economy.

The specific objectives are as follows:

- O1. Analysis of the macroeconomic context that influences the management of tailings ponds.*
- O2. Analysis of the strategic environment of Tailings Pond No. 1 Harghita-Băi from the perspective of environmental, economic, social, and industrial factors.*
- O3. Formulation of a strategy for the valorization of the resources existing in Tailings Pond No. 1 Harghita-Băi in accordance with the principles of the circular economy.*

2. Literature Review

Strategic management emerged as a response to changes in the economic environment that increased uncertainty in the business environment. In strategic management, analytical tools are used to evaluate the internal and external environment, which help in the formulation of organizational strategies (Nijssen & Frambach, 2001). The most commonly used are the STEPLE analysis, which examines macroeconomic factors (Yüksel, 2012) and the SWOT analysis, which evaluates strengths, weaknesses, opportunities, and threats (Helms & Nixon,

2010). Although these analyses were created for the economic environment, they can also be used in the context of the circular economy (Ferasso et al., 2020).

ESG refers to non-financial factors related to social and environmental sustainability, correlated with financial factors, which a company must take into account for more responsible business decisions towards the environment and the community (Foris et al., 2022; Koh et al., 2022). The integration of ESG principles into the organization's strategy allows the combination of short-term profitability with long-term sustainability (Frag, 2025). Mining activities can generate significant impacts on the environment, such as ecosystem degradation, landslides, and water contamination, increasing the need to integrate ESG principles into the management of these activities (Krause & Kretschmann, 2023).

In recent decades, the concept of the circular economy has been integrated into activities aimed at reducing waste and using natural resources efficiently (Geissdoerfer et al., 2017). The circular economy supports the reuse, recycling, and reintegration of materials into production chains (Kirchherr et al., 2017). Studies on the circular economy in the mining sector mainly analyze technologies and processes for recovering materials from mining residues for reuse in other industries. For example, the studies by (Tayebi-Khorami et al., 2019) and (Lèbre et al., 2017) analyze the role of the mining industry in the circular economy and propose resource management models for mining sites.

Other studies focus on technological methods for valorizing mining residues, such as the recycling of mining waste for the production of construction materials or ceramic materials (Farrokhi-Rad et al., 2017; Melashvili et al., 2016). The literature highlights the importance of geometallurgical analyses and technical tools for evaluating the economic potential of mining residues (Bye, 2011; Pineda et al., 2015). Additionally, other studies analyze the circular economy from the perspective of business models and industrial symbiosis (Lewandowski, 2016; Pajunen et al., 2012). In the mining industry, these principles can be applied to the valorization of tailings ponds (Teodosiu et al., 2014).

The mining industry generates approximately 10 billion tons of waste annually, a large part of which is represented by mining residues (Lacy et al., 2020). Studies show that mining residues may contain large amounts of economically valuable materials that can be reused in various industries (Mudd, 2010). Several authors highlight the potential of tailings ponds to be valorized as secondary industrial resources within the circular economy (Lottermoser, 2010). Thus, kaolinitic sand can be used in the construction materials industry and in the production of ceramic materials, being considered a secondary mineral resource with industrial valorization potential (Lottermoser, 2011). The global kaolin market is growing, driven by demand from the ceramics, paper, and construction materials industries (Barnes, 2018).

On the other hand, the improper management of tailings ponds can generate major risks for the environment and communities (Kossoff et al., 2014). This is illustrated in the literature by the collapse of the tailings pond at Stava, Italy, where 268 people died in 1985, leading to stricter management policies (Davies & Martin, 2009). Thus, the integration of circular economy principles into the strategic management of mining sites can transform risks into opportunities for sustainable economic development (Giurco et al., 2014).

However, the literature addresses the managerial dimension of tailings pond valorization in the circular economy only to a limited extent. The lack of an integrated managerial approach can limit the efficiency of applying circular economy principles and ESG policies in the management of mining residues.

In this context, the present study analyzes the case of Tailings Pond No. 1 in Harghita Băi, Romania, using strategic management tools, specifically the STEPLE and the SWOT analysis, to evaluate the strategic environment and identify directions for sustainable resource valorization.

3. Methodology

The chosen methodology is based on an exploratory qualitative approach, which allows the identification and interpretation of the relationships between economic, social, and environmental variables, facilitating the analysis of phenomena insufficiently explored in the literature (Marshall, 1996; Petrescu & Lauer, 2017).

The methodology integrates strategic management tools with the analysis of technical, economic, and industrial data. The study aims to identify factors influencing the management of mining sites and to evaluate the valorization potential of materials in tailings ponds. The research combines qualitative interpretation of the economic, legislative, and environmental context with the evaluation of technical and economic data relevant to resource reuse, in accordance with the principles of the circular economy and ESG standards.

The research design is of an exploratory case study type, applied to Tailings Pond No. 1 in Harghita Băi, Romania, owned by the company FAM MIHOC S.R.L. The exploratory case study method allows the analysis of a phenomenon through the use of multiple data sources that can be correlated (Yin et al., 2018). At the same time, the case study can contribute to the development and redefinition of the theoretical framework by formulating explanations based on empirical observations (Eisenhardt, 1989).

Several strategic management tools were used, adapted to the principles of the circular economy and the requirements for compliance with ESG policies. The external environment was analyzed using the STEPLE model, while the internal environment and resource valorization potential were evaluated through SWOT analysis. At the same time, empirical studies and theoretical frameworks highlighting the applicability of strategic management in the circular economy, in the context of ESG alignment, were analyzed.

The data required for the analysis were obtained from multiple sources. These include documents and technical information regarding the site of Tailings Pond No. 1 in Harghita Băi, Romania. The analysis included drilling data, topographic studies, and chemical analyses on the type and quantities of materials, as well as the characteristics of kaolin deposits in the Harghita Băi area and the quantities of kaolin and kaolinitic sand stored in Tailings Pond No. 1. Additionally, market studies regarding the industrial uses of kaolin and kaolinitic sand at the global and national levels were analyzed. Economic data were used, including a financial report and a research and development project related to FAM MIHOC S.R.L. In addition, the data were supplemented with public information regarding the conduct of mining activities in Romania and the management of tailings ponds.

4. Results and Discussion

4.1 Case study: Tailings Pond No. 1 Harghita-Băi, România

Starting from the 1950s, in the Harghita-Băi area of Romania, the mining exploitation of kaolin from a depth of approximately 60 meters was opened by Întreprinderea Minieră Harghita, a state-owned company during the communist regime. The mine extracted

approximately 220,000 tons of kaolinized rock annually, processed for use in the ceramics, paper, and industrial materials industries.

As a result of ore processing, the resulting residual materials were deposited in tailings ponds. Tailings Pond No. 1 in Harghita Băi was constructed in 1966 by damming the Hoţilor stream and was used for the storage of waste materials resulting from kaolin processing. The dam of the tailings pond has a height of approximately 14 meters and was constructed using the upstream raising method, utilizing the material deposited on the beach. The tailings pond has an area of approximately 16-17 hectares and a designed capacity of about 4 million tons of material, of which approximately 2.5–3 million tons are already stored. The material is mainly composed of kaolinitic sand with a grain size ranging between 0.42 and 3 mm, as well as local accumulations of kaolin mass resulting from the decantation process. After the closure of the mining exploitation, the site remained inactive for over three decades, being considered primarily a site with potential environmental risk.

4.2 STEPLE analysis of the Tailings Pond No. 1 Harghita-Băi, România

Table 1. STEPLE analysis of Tailings Pond No. 1 Harghita Băi, România

<u>Social factors</u> - Location in a tourist resort → local interest in environmental remediation. - The local community seeks to reduce environmental risks. - At the national level, attention to tailings ponds remains limited. - Public interest in sustainability and environmental protection is increasing.	<u>Technological factors</u> - Modern technologies are used for the recovery and processing of minerals. - Current equipment contributes to the reduction of operational costs. - Activity monitoring is carried out through digital systems. - Mining residues can be reused as industrial raw materials.
<u>Economic factors</u> - Existing deposits have value for sustainable industries. - Increasing energy costs influence the extraction process. - High kaolin prices in the EU → higher profitability. - Mining restrictions can generate new opportunities.	<u>Political factors</u> - EU strategies support the circular economy and the use of secondary resources. - Political instability influences the business environment. - Fiscal policies and royalty levels affect competitiveness.
<u>Legal factors</u> - Mining Law No. 85/2003 regulates the exploitation of resources. - Directive 2006/21/EC imposes strict management requirements. - Authorization procedures are managed by A.N.R.M.P.S.G.	<u>Enviromental factors</u> - Abandoned tailings ponds pose risks of soil and water pollution. - The rehabilitation of mining sites is a priority. - Resource valorization → contributes to reducing volume and risks. - Sustainable management → ecosystem protection.

Source: author's own researches

However, studies conducted between 1999 and 2001 highlighted that the materials stored in the tailings pond have valuable industrial properties. The analyses confirmed the possibility of obtaining several types of kaolin, including colloidal kaolin and washed kaolin used in the ceramics industry. At present, estimates indicate the existence of approximately 100,000 tons of pure kaolin and over 3 million tons of kaolinitic sand. Due to the natural aging of the material over several decades, the kaolin exhibits favorable characteristics for industrial uses, especially in ceramics, construction materials, agriculture, and cosmetic products,

while kaolinitic sand can be valorized in the construction materials industry and in the production of ceramic materials, being used as a raw material for the manufacture of bricks, ceramic tiles, or other cement-based products.

The results of the STEPLE analysis are included in Table 1, providing an overview of the social, technological, and economic dimensions that influence the valorization of resources from Tailings Pond No. 1 Harghita Băi, România.

The STEPLE analysis shows that the external environment exerts pressures and opportunities on the management of Tailings Pond No. 1 in Harghita Băi, România. Political and legislative factors, especially European policies on the circular economy, green transition, and ESG standards, facilitate the reuse of secondary mineral resources and the reduction of environmental risks. On the other hand, economic and technological factors represent the basis for integrating materials from the tailings pond into industries such as ceramics, construction materials, agriculture, and the cosmetics industry. To highlight the relationships between external factors and the process of sustainable valorization of resources from Tailings Pond No. 1 Harghita Băi, the authors propose a conceptual framework based on the STEPLE analysis and on the principles of ESG and the circular economy (Figure 1).

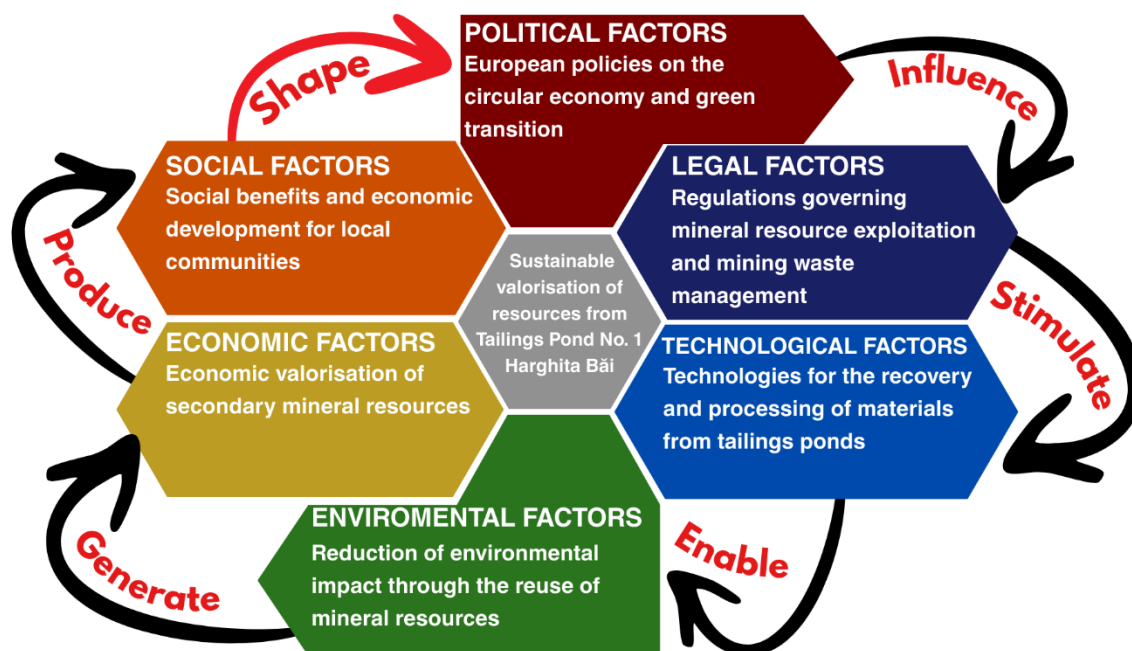


Figure 1. Conceptual framework linking STEPLE factors with the sustainable valorisation of resources from Tailings Pond No. 1 Harghita Băi, România

Source: author's own researches

The proposed model is based on the premise that European policies on the green transition, circular economy, and ESG standards, together with regulations on the management of mining waste, create pressure on the market for the development of more sustainable technologies. In this context, the political and legislative framework not only regulates extractive activities, but also creates the need for technological adaptation to meet new environmental and safety requirements.

The development of these technologies allows the controlled exploitation of resources from tailings ponds, reducing geotechnical risks and environmental impact through the application of circular economy principles. The valorization of secondary mineral resources generates economic benefits through job creation, reducing dependence on costly imports, and lowering production costs for industries that use these raw materials. At the same time, these economic effects contribute to the revitalization of the local community, considering that Harghita Băi is a mountain resort where the reduction of waste volume and the rehabilitation of mining sites will have a positive impact on the environment and local development. Finally, the resulting social benefits positively influence future political decisions, supporting initiatives aimed at the sustainable valorization of resources and environmental protection.

4.3 SWOT analysis of the Tailings Pond No. 1 Harghita-Băi, România

The SWOT analysis is presented in a summarized form in Table 2. It presents the existing advantages and opportunities, as well as the vulnerabilities associated with the management of the tailings pond, are presented.

Table 2. SWOT analysis of the Tailings Pond No. 1 Harghita-Băi, România

<u>Strengths</u> - Large quantities of kaolin and kaolinitic sand in the tailings pond - The materials have good quality → can be used in industry - Compact storage, making exploitation easier - Location in an area with tourism potential - No heavy metals, therefore safe for use	<u>Weaknesses</u> - Lack of technological infrastructure required for processing - Existing cracks → potential risk of instability - Degraded access road - No recent maintenance works have been carried out
<u>Opportunities</u> - Possibility of use in multiple industries (ceramics, construction, etc.) - Controlled exploitation can reduce the volume of residues - EU policies → support the circular economy - Possible access to European funds for environmental remediation	<u>Threats</u> - Increasingly strict environmental regulations - High costs for exploitation and environmental remediation - Unstable energy and fuel prices - The raw materials market is quite volatile - Competition from other suppliers exists

Source: author's own researches

The results of the SWOT analysis show that Tailings Pond No. 1 in Harghita Băi has significant potential for the valorization of secondary mineral resources, but this potential is conditioned by the need for strategic and investment interventions. Strengths, such as the significant quantities and quality of kaolin and kaolinitic sand, support the formulation of an SO strategy, aimed at integrating these resources into industries such as ceramics, construction, agriculture, and cosmetics. At the same time, the identified opportunities, particularly European policies supporting the circular economy and access to funding, support the formulation of a WO strategy, focused on the development of the technological infrastructure necessary for resource recovery and processing.

Considering the weaknesses, such as the lack of infrastructure and site instability risks, a WT strategy was formulated, aimed at ensuring the safety of the site through consolidation, monitoring, and maintenance works. Finally, in response to the identified threats, a ST strategy was developed, focused on the controlled exploitation of resources and the gradual reduction of the tailings pond volume, in compliance with environmental regulations.

4.4 Strategic implications and conceptual model of the Tailings Pond No. 1 Harghita-Băi, România

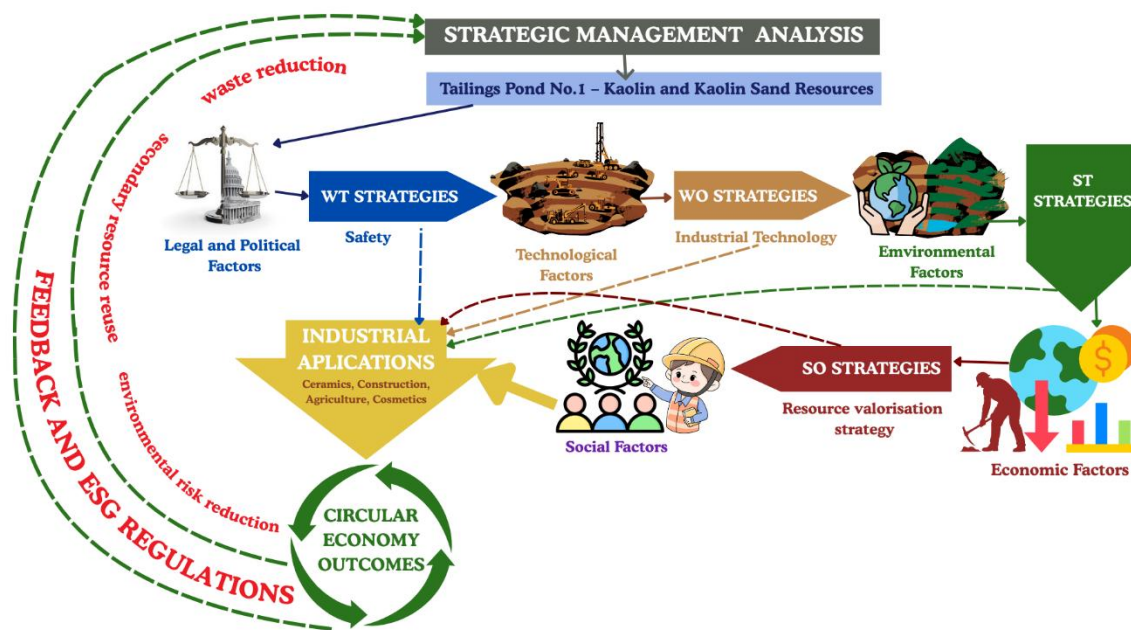


Figure 2. Conceptual model of strategic management for the valorisation of resources from Tailings Pond No. 1 Harghita-Băi, România

Source: author's own researches

To highlight how strategic management can be applied in the process of valorizing the resources existing in Tailings Pond No. 1 in Harghita Băi, the authors propose a conceptual framework based on the integration of STEPLE and SWOT analyses in the context of circular economy principles and ESG standards. The model starts from the influence of external factors on strategy formulation and implementation. In the first stage, external legal and political factors, such as European policies on the green transition, circular economy, and ESG standards, together with regulations on mining waste management, generate pressures on the extractive sector to adopt more sustainable practices. In this context, strategic management requires, first of all, the adoption of a strategy oriented towards the safety of the tailings pond (WT strategy), which involves reducing the risks associated with site instability through consolidation works, monitoring, and maintenance of the existing infrastructure.

The application of this strategy creates the necessary conditions for the intervention of technological factors, which allow the development of technical solutions and specific installations for the controlled exploitation of resources from the tailings pond. In this context, the WO strategy is implemented, oriented towards the development of the technological infrastructure required for the recovery of mineral materials stored in the tailings pond. The development of these technologies allows the monitoring of works carried out on the site, the management of tailings pond safety, and the installation of technological systems intended for the separation and valorization of secondary mineral resources. Once these technological infrastructures are developed, the application of the ST strategy becomes possible, mainly influenced by environmental factors.

The ST strategy involves controlled exploitation through the gradual removal of material (1 meter/year), reducing environmental and geotechnical risks. Through this approach, the

existing secondary mineral resources are valorized, contributing to the reduction of the volume of mining residues and the mitigation of environmental risks. At this stage, economic factors also intervene, stimulating the valorization of kaolin and kaolinitic sand resources through their integration into various industrial value chains. The SO strategy aims at the economic valorization of these mineral resources through their use in industries such as ceramics, construction materials, agriculture, and the cosmetics industry. The valorization of these resources can generate economic benefits by reducing dependence on costly imports, lowering production costs, and developing new economic activities. In turn, these economic benefits generate positive social effects, contributing to the revitalization of the local community in the Harghita Băi area.

The reduction of the volume of mining residues and the gradual rehabilitation of the site have a positive impact on the environment and local economic development, through job creation and the stimulation of related industrial activities. The integration of recovered resources into various industries leads to results specific to the circular economy, such as the reuse of secondary mineral resources, the reduction of mining waste, and the mitigation of environmental risks. These results generate a feedback mechanism towards the institutional and political environment, contributing to the consolidation of ESG policies and the development of strategies oriented towards the sustainable management of mineral resources.

4.5 Discussion of results and managerial implications

The analysis shows that the tailings pond should be viewed as a strategic asset rather than an environmental liability. The analysis of the present study reveals, overall, that the tailings pond should be viewed from a strategic management perspective as an important asset on which the purpose, mission, and overall strategy of the company can be founded. This perspective is supported by existing studies highlighting the economic potential of mining residues within the circular economy (Giurco et al., 2014; Lottermoser, 2010). Additionally, other studies emphasize that the integration of strategic management tools contributes to the identification of sustainable solutions for the valorization of mining sites and the reduction of environmental risks (Ferasso et al., 2020).

Viewing the tailings pond as an economic activity, the analysis of the external environment revealed both positive and negative attributes. Thus, in line with objective *O1*, opportunities consist of political and legislative support for initiating resource valorization activities at this site, interconnected with the need to counter environmental risks through technological, social, and economic components. In this regard, the STEPLE conceptual framework shows how external factors can be used to counter threats and demonstrate that the site can be transformed into a sustainable business.

The main advantage of this tailings pond is that it consists of materials that can be reused in various industries, such as kaolin and kaolinitic sand. These deposits are in the form of finished products, allowing their reuse without additional processing. Another advantage is the large quantity of deposits, which are safe for use even in industries for human use due to their low heavy metal content. These aspects indicate that the site is more a deposit of secondary mineral resources than a tailings pond containing mining waste, as it is currently considered and managed. Weaknesses relate to risks associated with site stability, the need for essential technologies, and external factors such as strict policies and economic fluctuations. As outlined in *O2*, four strategies were developed addressing environmental, economic, social, and industrial components.

The authors aimed, through the formulation of management strategies, to integrate both the negative and positive aspects of the mining site. To support this approach, a conceptual model was proposed, showing that the application of STEPLe and SWOT analyses facilitates the sustainable valorization of resources from Tailings Pond No. 1 in Harghita Băi. The results indicate that the strategic process should begin with site stabilization and safety, continue with the development of technological infrastructure, and lead to the controlled exploitation and economic integration of secondary mineral resources. Thus, objective *O3* was achieved. Moreover, the findings support the idea that strategic management can transform a site perceived as an environmental liability into a sustainable economic activity.

5. Conclusions

The results show that effective tailings pond management depends on appropriate strategies based on internal and external analysis. These factors are identified using strategic management tools such as STEPLe and SWOT analyses, which are adaptable to the specific context of a tailings pond. As shown by the research, strategic management must be tailored to the specific context, as reflected by the conceptual frameworks developed to outline how this passive asset can be transformed into a sustainable business. The case study shows that resource valorization reduces environmental risks and supports local economic development. The proposed strategy follows a phased approach, starting with site safety, continuing with technological infrastructure development, and leading to controlled exploitation and economic valorization of materials. Finally, the results show that the tailings pond can be viewed as a sustainable business, not just an environmental liability.

From a theoretical perspective, the research contributes to the literature by integrating strategic management tools into the analysis of tailings pond valorization, a field currently studied mainly from a technological perspective. From a practical perspective, the results provide recommendations for developing sustainable management strategies for mining sites, highlighting their potential to reduce environmental risks and support local economic development.

However, the study also has certain limitations. It is based on a single case study, which may limit the generalization of the results to other mining sites. In addition, the analysis is primarily strategic and conceptual, without including detailed economic evaluations of costs and profitability.

Future research could extend the analysis through comparative studies on other tailings ponds and by developing economic and technological feasibility analyses for the valorization of secondary mineral resources. It could also examine the long-term impact of these strategies on the environment and regional economic development.

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STRATEGIES FOR ORGANIZATIONAL RESILIENCE IN 10 ROMANIAN COMPANIES IN THE CONTEXT OF GLOBAL TRANSFORMATIONS. AN EXPLORATORY STUDY (STAGE I)

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Abstract: *In a global ecosystem marked by uncertainty – from logistical disruptions and geopolitical tensions to accelerated digital transformations – an organization's resilience can no longer be guaranteed by its financial resources alone. This paper presents the results of the first stage of an exploratory study, part of doctoral research, which investigates organizational resilience strategies in the Romanian business environment. The main objective is to analyze how organizations adapt their crisis management mechanisms and communication processes under the pressure of global uncertainty. The methodology adopted is qualitative, based on semi-structured interviews with general managers, owners, and PR specialists from 10 companies active in various sectors. The research is structured around eight fundamental themes, from defining the concept of crisis to post-event learning processes. Preliminary results highlight a dichotomy between the intuitive agility of local firms and the procedural rigor of multinationals, both converging, however, towards the need for "organizational intelligence" (Iacob & Cismaru, 2019). The findings emphasize that ethics and radical transparency are no longer mere public relations options, but essential strategic capabilities for maintaining legitimacy in the digital age. The paper aligns with the theme of the conference "Sustainability and Economic Resilience in the Context of Global Systemic Transformations," demonstrating that the long-term sustainability of organizations depends on their ability to transform disruptions into stored procedural experience. This initial stage lays the foundation for the subsequent expansion of the sample, providing valuable insight into how economic resilience is built through strategic communication and ethical responsibility in emerging economies.*

Keywords: *organizational resilience, crisis management, strategic communication, organizational intelligence, sustainability, reputation management.*

Classification JEL: M14, M10, L20.

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1. Introduction

In the contemporary business landscape, marked by an emerging "polycrisis" and unprecedented global systemic transformations, organizational resilience has ceased to be a mere competitive advantage, becoming a *sine qua non* condition for survival (European Commission, 2025). In this context, the way organizations process information and negotiate trust with stakeholders determines not only their ability to overcome the impasse but also their capacity for institutional learning.

The evolution of organizational resilience requires a shift from isolated defensive measures toward an integrated approach rooted in systems thinking. According to Manzini et al. (2025), resilience is not a static trait, but an emergent property of the entire organizational system, enabling managers to navigate the complex interdependencies between internal operations and volatile external environments. This systemic perspective provides the essential structural foundation for the transparent, two-way dialogue advocated by Kwiliński et al. (2025), effectively transforming communication from a mere support function into a vital feedback mechanism. Consequently, the organization functions as a coherent whole, capable of sustaining the strategic crisis navigation process described by Mafimisebi et al. (2025).

This article presents the results of the first stage of a broader exploratory study aimed at identifying the mechanisms through which companies in Romania adapt to these external pressures. This research aims to analyze how organizational leaders decode and manage these complex dynamics, emphasizing the vital role of communication in maintaining internal cohesion and external legitimacy.

To achieve this goal, our approach investigates eight fundamental pillars, which also constitute the specific objectives of the research. This research proposes a holistic approach to the phenomenon of crisis, starting with its conceptual definition in various industries in order to decode the meanings attributed to it in a context of instability. The central objectives aim to dissect crisis management mechanisms through the lens of decision-making agility and leadership, while also exploring external and internal communication strategies, with a particular focus on managing uncertainty at the organizational culture level. The study also assesses the strategic role of communication professionals in informing management decisions, while investigating ethical dimensions based on honesty and responsibility. Finally, the research aims to prioritize dialogue with the media and stakeholders, analyzing how the crisis experience is converted through learning and evaluation into sustainable prevention strategies for the future. Given the exploratory nature of the first stage of the research, the study does not start from pre-established hypotheses, but uses research questions derived from the eight themes of the interview guide.

By addressing these issues, the study seeks to provide a nuanced perspective on resilience in the Romanian context, highlighting how transparency and procedural rigor can transform vulnerability into an opportunity for strategic maturation. This first stage lays the foundation for a deep understanding of how organizations build their reputational "shield" (Coombs, 2007) in a world where the only constant is change. By bridging these theoretical frameworks with the lived experiences of Romanian SMEs, this study contributes to a more nuanced understanding of how decentralized, dialogue-based structures can outperform centralized hierarchies in times of global instability.

2. Literature Review

The evolution of crisis management has marked a fundamental transition from a purely reactive perspective, focused on limiting immediate damage, to a proactive model based on strategic resilience and systemic adaptation. At the heart of this new narrative lies the concept of "organizational intelligence," defined by Iacob and Cismaru (2019) as the collective ability to process signals from the environment and transform the raw experience of crisis into strategic knowledge stored in the firm's procedural memory. This ability becomes critical in the context of contemporary "polycrises," where systemic shocks force organizations to reassess their structural stability and institutional learning capacity under the pressure of global uncertainty (Iacob & Cismaru, 2019; Kwiliński et al., 2025).

In substantiating modern resilience, Manzini et al. (2025) propose a shift from reactive strategies to a paradigm based on systems thinking. The authors argue that resilience should not be treated as an isolated variable, but as an emergent property resulting from the harmonious interaction of all organizational components.

Organizations that successfully navigate systemic shocks are not necessarily those with the most extensive financial resources, but those that cultivate and maintain a transparent, two-way dialogue with the entire stakeholder ecosystem, from employees and investors to customers and authorities (Kwiliński et al., 2025). According to the same vision, radical transparency transforms stakeholders from passive observers into partners in resilience, ensuring systemic stability that financial resources alone cannot guarantee (Kwiliński et al., 2025).

If resilience is conditioned by the quality of dialogue with stakeholders (Kwiliński et al., 2025), effective success in managing unpredictable situations lies in the ability of leaders to become true 'masters of uncertainty'. According to the qualitative study conducted by Mafimisebi et al. (2025), organizations with high strategic resilience do not try to eliminate uncertainty through rigid planning, but learn to navigate it through flexibility and contextual decisions. A central pillar of recent literature emphasizes the importance of two-way, transparent communication with stakeholders as an essential mechanism for managing uncertainty. Another important pillar of the literature is the Situational Crisis Communication Theory (SCCT), which emphasizes that reputation is a volatile asset that depends on the degree of assumed responsibility (Coombs and Holladay, 2012).

However, recent digital transformations have introduced the concept of "paracrisis," where seemingly minor incidents on social media can quickly escalate into a major image crisis. Kwiliński et al. (2025) argue that organizations that manage to maintain this dialogue not only survive external shocks but also strengthen their long-term resilience by cultivating trust as a strategic asset. In the digital age, this reputation becomes a "verifiable strategic asset," where any discrepancy between stated ethical values and concrete actions is immediately sanctioned by the public, requiring constant monitoring of "paracrisis" phenomena (Cismaru, 2022; Coombs & Holladay, 2012).

The literature highlights the role of leaders in balancing the paradoxical tensions of internal communication, using empathetic and symmetrical leadership models to ensure credibility among employees (Heide & Simonsson, 2015; Men, 2015; Sharples et al., 2023). While multinational organizations rely on procedural rigor and compliance systems, firms in emerging economies tend to resort to agility and personalized leadership, reflecting the need

to constantly adapt to disruptions in vital flows (Boin et al., 2005; Grunnan & Fridheim, 2017; Iacob & Cismaru, 2019).

Heide and Simonsson (2014) argue that effective internal communication management acts as a shield against disruptions, while empathetic and symmetrical leadership stimulates workforce engagement in times of tension. Success in managing contemporary crises depends on the organization's ability to maintain a two-way dialogue with stakeholders and to practice active "organizational listening" (Macnamara, 2022) in order to integrate their concerns into the strategic response.

Ultimately, sustainability and economic resilience depend on the capacity for "organizational listening" and integrating lessons learned (Macnamara, 2022; Cioacă and Briciu, 2017; Kwiliński et al., 2025). Transforming a traumatic experience into an opportunity for growth depends on shifting from "buffering" strategies to "bridging" strategies in relation to the external environment (Cioacă & Briciu, 2017; Kim & Krishna, 2017).

Thus, radical transparency becomes an essential strategic capability in an environment marked by global systemic transformations, and organizational resilience is a dynamic learning process that allows vulnerabilities to be transformed into sustainable strategic expertise (Cioacă & Briciu, 2017; Iacob & Cismaru, 2019; Kwiliński et al., 2025).

3. Methodology

This research adopts an exploratory qualitative approach, representing the initial stage of a broader scientific endeavor integrated into the doctoral thesis entitled "Crisis Management in Public Relations." The choice of qualitative methodology is justified by the need to decipher the subjective nuances and complex decision-making mechanisms that organizational leaders activate under pressure. The purpose of this first stage is to identify behavioral patterns and resilience strategies in a diverse sample, providing the contextual depth necessary to substantiate future working hypotheses of the research.

The main tool for data collection was the semi-structured interview, a method that offers the optimal balance between thematic rigor and the flexibility needed to explore new perspectives offered by respondents. The sample for this stage included 10 companies operating on the Romanian market in various sectors (real estate, logistics, industrial production, retail, shipping, and healthcare services). The interviews were conducted with employees in strategic positions, such as general managers, business owners, PR and marketing managers, thus ensuring an overview of both the operational and reputational dimensions of crisis management.

The interview guide was designed to reflect the strategic objectives of the research, structured around eight fundamental themes that cover the chronology and complexity of a crisis. It begins with a conceptual definition of crisis to capture leaders' perceptions of current risks, continuing with an analysis of crisis management through the lens of decision-making processes and response structures. The communication dimension is explored multidimensionally, targeting both external communication strategies and the construction of messages to the public, as well as internal communication, focused on maintaining team morale and cohesion. Strategically, the tool assesses the role of communication professionals in informing decisions, while also investigating ethical dimensions through the lens of honesty and social responsibility. The end of the interview

prioritizes media and stakeholder relations to identify the hierarchy of dialogue with stakeholders, culminating in learning and evaluation processes, which are essential for integrating the crisis experience into organizational memory.

This preliminary stage serves as the foundation for the second phase of qualitative research, which will expand the sample to 20 companies to include additional sectors and saturate the collected data. Subsequently, the results extracted from these in-depth interviews will be used to develop quantitative research tools. This methodological trajectory ensures a coherent transition from the phenomenological understanding of crises to measuring their magnitude in the Romanian business environment.

This research adopts a sequential exploratory design, in which the qualitative data extracted from the 20 in-depth interviews serve to substantiate and refine the quantitative instrument (the questionnaire). Correlating the two stages allows for the triangulation of the managerial perspective with that of the workforce, providing a holistic view of resilience.

The qualitative results provide the 'depth' of the Romanian context, while the quantitative stage involving 200 respondents will provide us with the 'breadth' necessary to statistically validate the hypotheses regarding the relationship between organizational intelligence (Iacob & Cismaru, 2019) and reputational sustainability (Cismaru, 2022).

The selection of study participants was guided by a set of rigorous criteria designed to ensure a good representation of the investigated phenomenon. Firstly, emphasis was placed on professional expertise and hierarchical position, with only senior management leaders (CEOs, Managing Directors) or communication and compliance department coordinators being recruited, thus ensuring access to the organization's strategic vision and decision-making mechanisms. Secondly, validation through sectoral diversity was sought, with the sample including representatives from distinct industries – from heavy industry and manufacturing to real estate, services, and retail – which allowed for a comparative analysis of the perception of logistical versus reputational risks.

This heterogeneity was complemented by capital typology, including both local entrepreneurial firms and branches of multinational organizations, facilitating the identification of the dichotomy between local agility and international procedural rigor. By applying these filters, the aim was to reach a theoretical saturation point, where the information obtained would provide a deep understanding of systemic adaptation mechanisms, beyond simple statistical generalizations.

Data collection and processing

The field research was conducted between March and October 2025, during which time the ten semi-structured interviews were conducted. To ensure data accuracy and compliance with ethical standards, all interactions were audio recorded with the prior consent of the participants and subsequently transcribed in full (verbatim).

With regard to information processing, a qualitative content analysis was performed manually, without the use of CAQDAS software (e.g., NVivo or ATLAS.ti). This methodological decision was based on the desire to maintain maximum proximity to the source text and to capture the subtle nuances, pragmatic inflections, and specific context of each respondent, elements that can sometimes be diluted by automated coding.

The data interpretation process followed an iterative procedure, structured in three distinct stages, designed to ensure the depth and validity of the analysis. In the first phase, immersion in the data was achieved through repeated and in-depth reading of the transcripts, facilitating familiarization with the nuances of each respondent's discourse and identifying the dominant tone of the interviews. Subsequently, thematic coding was performed, a stage in which units of meaning were isolated and grouped into relevant categories such as organic resilience, communicational transparency, and internal dynamics. Finally, the synthesis and validation stage involved corroborating these emerging categories with the existing theoretical framework (Manzini et al., 2025; Kwiliński et al., 2025), allowing the raw data to be transposed into the structured conclusions presented in the results section.

4. Results and Discussion

A comparative analysis of the ten case studies reveals a transformation in the way Romanian organizations process the contemporary "polycrisis" (European Commission, 2025). The results indicate that "organizational intelligence" - defined by Iacob and Cismaru (2019) as the ability to integrate environmental feedback into decision-making structures - is the foundation of systemic resilience. This ability to adapt is being tested by major external factors, such as the need for citizens to secure supplies in case of instability (AP News, 2025), a phenomenon that reflects the state of global uncertainty.

In terms of crisis taxonomy and risk perception, the research results reveal that respondents do not define the phenomenon as an isolated event, but rather as a fundamental disruption of vital organizational flows. This perception varies significantly depending on the specific sector: in heavy and manufacturing industries (R3, R7, R8, R9), the crisis is dictated by supply chain volatility and logistical pressures, while for consumer-oriented sectors (R4, R5, R6, R10), the main vulnerability is reputational and digital in nature. At the same time, there is a keen awareness of the concept of "paracrisis," where seemingly minor incidents can quickly escalate online, requiring constant monitoring to prevent them from turning into major image crises. This nuance of risk confirms the need for careful monitoring of the digital environment to ensure reputational stability in the context of current global transformations.

The analysis of management processes highlights a marked distinction between the agility specific to the "one-man band" in small companies and the systemic rigor that defines multinationals. While local leaders frequently resort to "strategic improvisation" to overcome immediate operational bottlenecks, international organizations, such as those identified in case studies R3 and R5, base their responses on detailed crisis manuals and rigorous simulations.

Resilience as a function of relational capital

Empirical analysis of the 10 interviews reveals that SME managers often intuitively adopt the systemic thinking model theorized by Manzini et al. (2025). Unlike rigid corporate structures (such as R5), where responsibilities are fragmented, local business leaders (e.g., R1, R9, R10) demonstrate a deep understanding of how a disruption at one point in the system - whether in the supply chain or a legislative change-reverberates throughout the entire stakeholder ecosystem. For example, in the case of R9, resilience was the result of a holistic vision that linked strategic raw material procurement with proactive customer education and transparency toward authorities. This ability to process the organization as an

interconnected system allowed the subjects to identify vulnerabilities before they escalated into critical crises, confirming Manzini's thesis that systemic thinking is the foundation of sustainability in conditions of systemic instability.

This research confirms the validity of the model proposed by Kwiliński et al. (2025), according to which organizational survival in the face of systemic shocks goes beyond the sphere of financial resources and is intrinsically linked to the quality of dialogue with stakeholders. During the interviews, it was observed that Romanian SMEs (R1, R6, R7) often compensate for the lack of massive capital reserves with extremely high "communicational agility." This form of relational resilience manifests itself through direct and honest channels, which allow workflows to be adapted in real time, validating the hypothesis that transparency functions as a strategic asset that reduces uncertainty.

Navigating uncertainty through agile decision-making and "strategic improvisation"

The results of the analysis highlight that the Romanian SMEs in the sample do not approach crises as events that need to be "solved" using predefined recipes, but as continuous flows that require adaptive navigation, confirming the "Master of Uncertainty" profile proposed by Mafimisebi et al. (2025). In the interviews analyzed (especially R1, R2, and R6), strategic resilience was operationalized through a remarkable ability to make decisions in the absence of complete data, relying on managerial intuition and rapid adjustment of operational processes. This "strategic improvisation" – observed, for example, in the recalibration of assemblies at R6 or in securing stocks at R1 – demonstrates that success in the face of systemic disruptions does not belong to organizations that try to eliminate uncertainty, but to those that learn to use it as a catalyst for tactical innovation and resource optimization.

In the real estate sector (R10), the manager did not limit himself to complying with the rules, but adopted a posture of lifelong learning ("we learn throughout our lives"), reflecting precisely the adaptability needed to transform a hostile context (lack of parking infrastructure) into a competitive advantage through transparency, confirming the the profile of the "navigator in uncertainty" described by Mafimisebi et al. (2025).

Operationalizing two-way dialogue in the entrepreneurial environment

In contrast to the procedural rigidity of multinationals, the local firms analyzed use two-way dialogue as a mechanism for preventing "crises." Respondents from technical sectors (R9 - stone and marble, R10 - real estate) emphasize the importance of prior customer consultation and constant verification of their expectations. This approach transforms communication from a PR function into an essential component of quality control. Thus, by maintaining a constant connection with the "stakeholder ecosystem" (suppliers, installers, end customers), these organizations manage to prevent execution errors that could trigger major reputational crises, perfectly illustrating Kwiliński's thesis on dialogue as a factor for survival.

Internal dimension: Employees as pillars of systemic resilience

The analysis of the results highlights that, regardless of the organizational profile, internal communication was identified as a critical factor of resilience in times of instability. In companies with domestic capital, such as those identified in case studies R1 and R6, there is a preference for a "family" type of interaction model, where team cohesion is based on empathy and the direct credibility of the leader. In contrast, multinational organizations opt for the implementation of hierarchical and clearly structured information flows.

In this complex ecosystem, the communication specialist becomes a true strategic "sensor," with the critical role of decoding external pressures and translating them into coherent internal messages. This function is essential for balancing the paradoxical tensions that inevitably arise during a crisis, thus ensuring the stability and alignment of the organization through "organizational listening" processes. Through these mechanisms, professionals in the field contribute directly to strengthening organizational intelligence.

Employee loyalty and internal dialogue

The research highlights that systemic resilience starts from within the organization, by maintaining an open channel with employees, who are seen by respondents as the 'first sensors' of the crisis. In line with the model proposed by Kwiliński et al. (2025), SME managers (R1, R8) reported that their priority during systemic shocks (e.g., the pandemic) was to maintain the workforce, even at the cost of immediate financial losses. This honest dialogue about the state of the company generated a capital of trust that allowed organizations to resume operations quickly.

A significant finding of the study concerns how dialogue with employees becomes a protective shield for the entire organization. In line with the vision of Kwiliński et al. (2025), SME managers (R1, R8) report that maintaining internal transparency during periods of disruption (e.g., pandemic or rampant inflation) took priority over immediate profitability. The deliberate choice to retain the workforce and communicate honestly about the company's prospects created a capital of loyalty that ensured a rapid post-crisis recovery. In contrast, the multinational analyzed (R5) tends to depersonalize this dialogue through global protocols, which, while providing stability, can make the organization vulnerable by losing the "human sensors" that are the first to detect signs of an impending crisis.

Transparency as a shock absorption mechanism

The results of the qualitative analysis confirm the thesis put forward by Kwiliński et al. (2025) regarding the primacy of dialogue over financial resources. In the case of SME subjects (e.g., R1, R6, R7), resilience was activated through what respondents call "radical sincerity" in their relationships with business partners. For example, in the interior design sector (R6), immediate recognition of installation errors and transparent communication of solutions transformed potential image crises into opportunities to strengthen customer loyalty. This behavior demonstrates that, for small and medium-sized companies, two-way dialogue acts as a more effective risk buffer than rigid corporate procedures.

The ethical dimension of communication has undergone significant evolution, moving beyond the stage of a simple moral imperative to become a verifiable strategic asset in the digital economy. In this sense, the organizational leaders analyzed, especially those in the industrial and real estate sectors, adopt a strategy of "radical transparency" as a central pillar in maintaining relationships with stakeholders. This approach involves honestly acknowledging technical or operational limitations rather than maintaining a defensive silence, with managers preferring immediate vulnerability to long-term reputational risks.

Reflective learning and transforming vulnerability into expertise

A critical dimension of the study, which resonates with the vision of Mafimisebi et al. (2025), is the transformation of crisis from a threat into a process of profound organizational learning. Respondent R10 (real estate developer) summarizes this stance by stating that "we learn throughout our lives," indicating that strategic resilience is fueled by intellectual

curiosity and openness to new terminology and working methods. This "mastery" in managing the unpredictable manifests itself through the internalization of lessons learned from infrastructure or communication crises and their transformation into higher technical standards (e.g., exceeding parking regulations).

A key finding of the study confirms the thesis put forward by Manzini et al. (2025), according to which resilience functions as an emergent property of the organizational system. The interviews revealed that in companies where decision-making is centralized and dialogue is fragmented, the response to the crisis was disjointed and ineffective. In contrast, organizations that adopted, even intuitively, systems thinking managed to harmonize the interdependencies between departments, ensuring systemic stability that material resources alone cannot guarantee (Manzini et al., 2025).

Table 3. Differences in resilience (Local vs. International)

Criterion	Local / SME (R1, R2, R4, R6, R7, R8, R9)	Multinational (R3, R5, R10)
The source of the power	Leadership agility and expertise	Systemic standardization and resource allocation
Adaptation	In stride, through organic learning	Through procedural and technological updates
Client Relations	Partnership, friendship, and empathy	Predictability, compliance, branding

Source: Authors' own elaboration

The analysis indicates that transparency and two-way dialogue are not just ethical choices, but represent the technical foundation of corporate longevity. In full agreement with the perspectives of Kwiliński et al. (2025), the research shows that maintaining an honest exchange of information with the stakeholder ecosystem - from employees to authorities - functions as a risk buffer.

5. Conclusions

This research highlights the fact that resilience in the current context of polycrisis can no longer be reduced to a simple capacity for financial recovery, but represents a profound reconfiguration of organizational identity. By corroborating the data extracted from the ten interviews with emerging literature, the study demonstrates that the success of Romanian SMEs in the face of systemic shocks is the result of a symbiosis between management structures and the quality of communication flows. This approach validates the transition from reactive to strategic resilience, in which the organization not only withstands the impact, but processes it as a necessary stage in its internal evolution.

The study highlights a distinct profile of the Romanian SME manager, defined by the ability to become a "master of uncertainty." According to the model proposed by Mafimisebi et al. (2025), strategic resilience is fueled by decision-making agility that accepts unpredictability as a constant. Our results show that leaders who demonstrated openness to continuous learning and adaptation managed to transform logistical or personnel vulnerabilities into competitive advantages, marking the difference between passive survival and post-traumatic growth of the firm (Mafimisebi et al., 2025).

A nuanced conclusion of the research concerns the contrast between Romanian entrepreneurial firms and branches of multinational organizations. While the latter benefit from rigorous global procedures, local SMEs demonstrate superior "organic resilience" in times of sudden systemic change. This flexibility allows SMEs to recalibrate processes in real time, confirming that in volatile economic environments, flat structures and direct communication channels are often more effective than complex hierarchies in maintaining team cohesion.

Another fundamental dimension revealed is the convergence towards what Iacob and Cismaru (2019) define as "organizational intelligence." The results show that this information processing capacity is not only an intangible asset, but also becomes an essential strategic capability for maintaining legitimacy in the digital age (Iacob & Cismaru, 2019). The research confirms the hypothesis that economic sustainability is inextricably linked to systemic vision, where the ability to learn from disruptions transforms crisis from a critical point into a resource for procedural innovation.

The research also highlights that ethics and radical transparency in emerging economies have moved beyond superficial communication, becoming a component of systemic resilience. By correlating the data with the perspectives of Kwiliński et al. (2025), the study demonstrates that two-way dialogue and honesty in times of uncertainty function as mechanisms for reducing vulnerability. This approach allows organizations to maintain their reputational capital even in the face of major logistical or geopolitical disruptions by integrating social responsibility into the core of their business strategy.

Beyond the immediate managerial implications, the results of this study provide valuable insights for economic policymakers, in line with the strategic autonomy directions promoted at the European level (European Commission, 2023). The study highlights the need for support programs aimed at strengthening strategic literacy and communication resilience in the SME sector. Public policies should encourage the creation of trust-based collaborative networks, recognizing that the resilience of an emerging economy is the sum of the adaptive capacities of its component micro-systems.

Research Limitations

Despite its theoretical and practical contributions, this exploratory research has a number of limitations that also point the way for further studies. Firstly, the small sample size, based on ten case studies, allowed for an in-depth qualitative analysis, but limits the possibility of statistical generalization to the entire Romanian business environment. Second, the nature of the data collected introduces a degree of subjectivity in perception, as the responses of the leaders interviewed may be nuanced by social desirability or an implicit intention to protect the public image of the organization, despite assurances of confidentiality.

Last but not least, the geographical concentration of most of the companies analyzed in the Southeast region introduces a regional specificity in crisis management – such as critical dependence on port logistics – which limits the direct applicability of the results in areas with different economic dynamics.

Future research directions

Future research directions will follow a sequential mixed-methods design, structured into two complementary phases. Initially, the qualitative sample will be expanded to 20 organizations, facilitating the achievement of theoretical saturation and the inclusion of

different sectors of activity. The findings from these in-depth interviews will provide the foundation for developing a quantitative research instrument, which will subsequently be administered nationwide to a sample of 200 respondents (middle management and frontline employees). This approach will allow for the triangulation of strategic managerial vision with the systemic perception of the Romanian workforce, providing statistical validation for the organic-adaptive resilience model identified during the exploratory stage.

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LOCAL ECONOMIC DEVELOPMENT IN HUNGARY – THROUGH THE EXAMPLE OF A DISADVANTAGED SETTLEMENT

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Abstract: In 2011, the public employment system in Hungary underwent a complete overhaul. This active employment policy tool is a unified public employment system designed to alleviate unemployment caused by the global economic crisis, but it had already been in place in Hungary for decades. Public employment has been criticised because it does not return the unemployed to the primary labour market, with most of them stuck in this temporary solution. The research presents the good practices of local economic development in a disadvantaged, low-population settlement (Szemere), which started with public employment. Local economic development initiatives of this kind are crucial in Hungary, as the settlement structure in Hungary is characterised by a large number of small villages, where job opportunities in the primary labour market are limited. The research is based on a qualitative case-study approach combined with field research conducted in Szemere settlement in Hungary. The study analyses the local development strategies, employment effects, and community impacts.

Keywords: labour market; local development, Szemere settlement.

Classification JEL: R23.

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1. Introduction

Local Economic Development (LED) emerged in the early 1970s as municipalities recognised that businesses and capital are mobile across different geographical locations in search of comparative advantages (Beauregard, 1993). By assessing the foundations of their economies, local communities were able to better understand the factors that hindered or facilitated economic growth and investment expansion. Equipped with this new knowledge, communities sought to broaden the foundations of their economies and employment through strategically planned programs and projects. These initiatives aimed to eliminate potential barriers and promote investment (Malizia et al., 2020).

Today, the economic success of every settlement depends on how effectively it can adapt to the dynamically changing local, national, and international market economy. Systematically developed LED approaches are increasingly used worldwide by settlements seeking to strengthen their local economic capacity and improve the competitiveness and productivity of local industries, businesses, and workers. A community's ability to raise living standards, create new economic opportunities, and overcome poverty largely depends on how well it understands the processes of LED and how effectively it can respond to the challenges of a changing and competitive market economy (Bartik, 1991).

2. Literature Review

Various definitions of local economic development exist; however, its main objective is to improve the quality of life of the local population. In this approach, cooperation prevails

over competition, and the effectiveness of social capital is emphasized rather than the efficiency of private capital (Faragó, 1994).

According to Mezei (2006), local economic development is a conscious intervention in the life of the local economy that utilises external and/or internal resources. The initiative may originate from external actors (e.g., government, the European Union, or foreign capital); however, the key to the process is the participation of local stakeholders. These actors may participate either as initiators or as supporters and shapers of externally proposed development initiatives.

Swinburn et al. (2004) argue that local economic development aims to build the economic capacity of a region in order to secure its economic future and ensure an adequate standard of living for its population. It is a process in which public authorities, local governments, entrepreneurs, and private sector partners collaborate to create more favourable conditions for economic growth and the labour market. It can be concluded that the economic success of any settlement today depends on how well it can adapt to the local, national, and international market economy. In this regard, local economic development plays a key role. The planning and implementation of local economic development strategies are determined by the economic, social, and physical characteristics of a settlement (Fleischmann et al., 1992).

Whether a community can create new economic opportunities, improve its standard of living, and overcome poverty depends largely on how well it understands these processes and how it responds to the ongoing challenges of the market economy. If a locally based employment-centred system operates effectively, it can provide a predictable quality of life. Jobs created by local small and medium-sized enterprises are strongly embedded in the local economy, thereby providing stability for local economic systems. Another advantage is that when the local business environment is supportive, profits generated from local resources tend to remain within the community and contribute to its further development (Tóth, 2007).

3. Methodology

Szemere is a settlement located in the northeastern part of Hungary, in Borsod-Abaúj-Zemplén County, approximately 5 kilometres from the Slovak border, within the Encs district and about 19 kilometres from the town of Encs. More than 5 kilometres of the administrative boundary of the settlement coincide with the state border.

The settlement of Szemere was first mentioned in written sources in the first half of the 13th century. In terms of its administrative status, Szemere is classified as a village and operates within a joint municipal office system, the seat of which is located in Szalaszend. The total population of Szemere is 384 residents.

The diagram illustrates the number of permanent residents at the end of each year. From a demographic perspective, the settlement is in a relatively favourable position compared to the national average. As shown in the previous diagram, the population has not decreased significantly over the past ten years.

Examining the data from the last decade, it can be observed that the population increased between 2015 and 2019. After that period, by 2022 the population of the settlement had almost returned to the same level as in 2015. The population figure for this year is also identical to that recorded ten years ago.

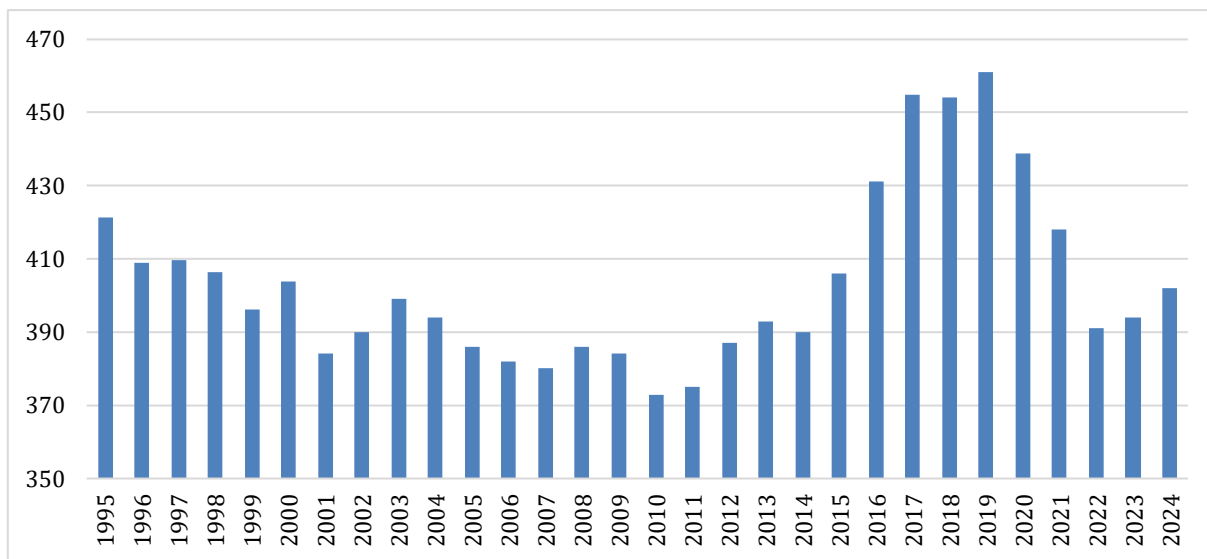


Figure 1. Population trends in Szemere between 1995 and 2024

Source: www.statinfo.ksh.hu

In my opinion, one possible reason for the decline could be the COVID-19 pandemic, as the number of deaths increased significantly in 2020–2021, when the population began to show a decreasing trend. Another reason may be that many people are unable to find employment in the region or in nearby settlements and therefore leave their homes in search of more attractive job opportunities.

Closely related to the number of permanent residents are the next two diagrams, which clearly illustrate the trends in migration as well as live births and deaths over the past ten years.

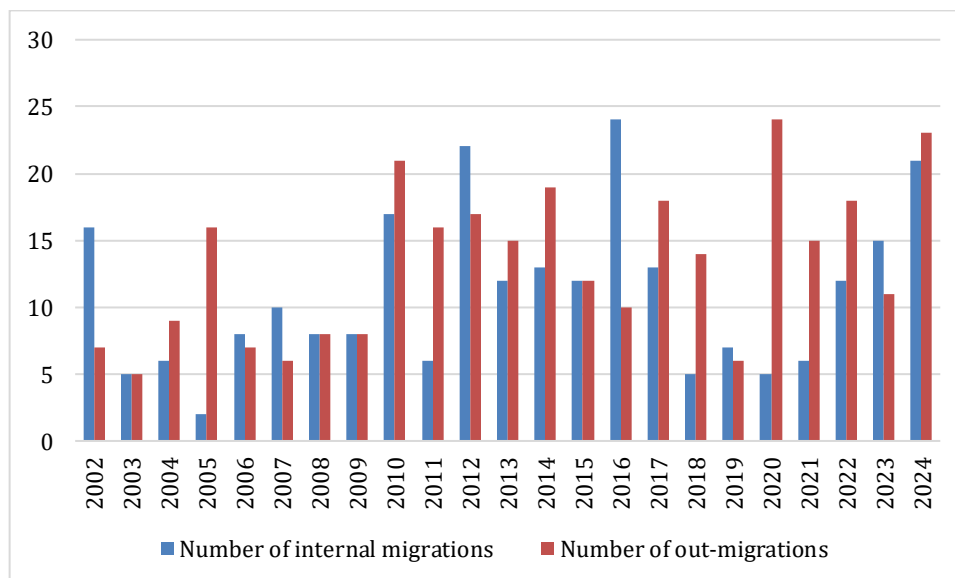


Figure 2. Trends in migration in Szemere between 2002 and 2024

Source: www.statinfo.ksh.hu

It can be stated that during the past ten years, the number of in-migrations was either equal to or higher than the number of out-migrations in seven years. During the examined period, the highest number of out-migrants occurred in 2020; in my opinion, this may again be attributed to the negative effects of the pandemic period.

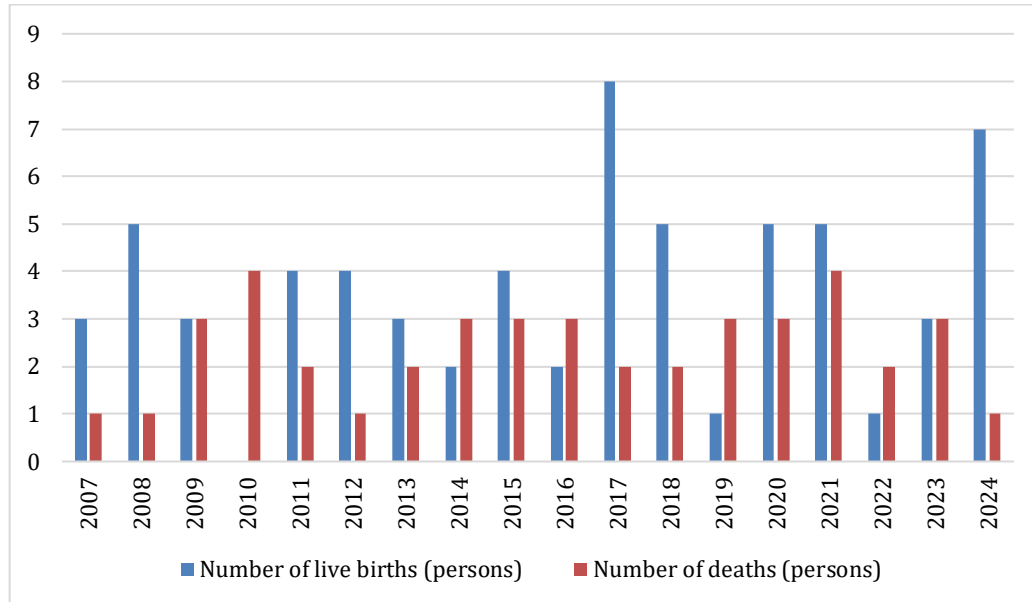


Figure 3. Number of live births and deaths, 2007–2024

Source: www.statinfo.ksh.hu

The number of live births in the settlement ranged between 4 and 13 over the past decade, with the “baby boom” in 2017 standing out. In two years, 2014 and 2021, the number of births was lower than the number of deaths in those respective years. In the latter case, this may again be attributed to the effects of the global pandemic, which was a period marked by uncertainty.

The current population structure of Szemere is ageing; the proportion of Roma residents is high, and the unemployment rate is above the national average. From an employment perspective, disadvantaged groups include older people approaching retirement age, women returning to the labour market after childbirth, and people with reduced work capacity and disabilities. In addition, labour market participation among the 15-24 age group is relatively low.

Entrepreneurial willingness and business activity in the region are extremely low. The settlement is not served by railway transport; the nearest railway station is located 13 km away in Méra. The only form of public transportation available is the Volán bus service. Szemere is located approximately 60 km from the county seat, the city of Miskolc.

A high unemployment rate can be observed in the village, partly due to its location in Abaúj, one of the most disadvantaged regions of the country. The district centre, the town of Encs, can only be reached by bus, and even there, employment opportunities are limited and are mostly filled by residents or people from nearby settlements.

Among the operating businesses, a significant proportion are small-scale enterprises employing only a few people, often characterised by limited capital and operational difficulties, frequently referred to as “necessity enterprises.” The emergence of well-capitalised businesses is discouraged by inadequate infrastructure and the lack of a skilled workforce.

4. Results and Discussion: Public employment in Szemere

At the beginning of 2011, the public employment system in Hungary underwent a complete transformation. A unified public employment system was established to address the unemployment caused by the global economic crisis. Its main objective was to activate people who had been excluded from the labour market by providing useful, value-creating employment (“work instead of welfare”), helping them maintain their work capacity and acquire work routines that could facilitate their integration into the primary labour market.

The public employment system gained an unexpectedly significant role. In 2014, more than 560,000 people participated in various public employment programs funded by approximately 230 billion HUF of public resources, which was considered extremely high even by international standards. Another characteristic of the Hungarian system is that participants do not enter into a traditional employment relationship but rather into a public employment legal status, which is similar to fixed-term employment. Participants are entitled to social security benefits and 20 days of paid annual leave; however, their wages do not reach the guaranteed minimum wage. As a result, public employment offers less favourable conditions and thus only imitates regular employment, aiming to encourage participants to seek jobs in the open labour market and eventually reintegrate successfully into the primary labour market.

Public employment, which creates jobs through state funding, currently serves three main purposes: reducing poverty, improving employability, and providing public goods. In Hungary, the establishment of the agricultural public employment system is linked to the second objective – improving employability – and it was also launched in 2011 under the name Start Work pilot program (Startmunka mintaprogram). The essence of this employment policy tool was that the available resources could only be used for regional and settlement development in disadvantaged micro-regions and settlements. It targeted areas of the country characterized by persistently high unemployment and the accumulation of social problems.

Public employment provides temporary work opportunities for individuals whose independent job search has been unsuccessful for a long time. This is also the case in Szemere, where, unfortunately, almost the same individuals have been returning to these programs for years.

All the information I obtained about public employment comes from an interview with an employee of the Mayor’s Office. I did not have the opportunity to ask my questions in person; therefore, I contacted the office by telephone. The answers to my interview questions were not provided by the mayor, Ferenc Farkas, but by Adrienn, an employee of the municipality who, among many other responsibilities, is also involved in tasks related to public employment and the social cooperative.

The following diagrams clearly illustrate the total number of participants in public employment in the settlement over the past ten years, as well as the number of individuals employed within different forms of public employment.

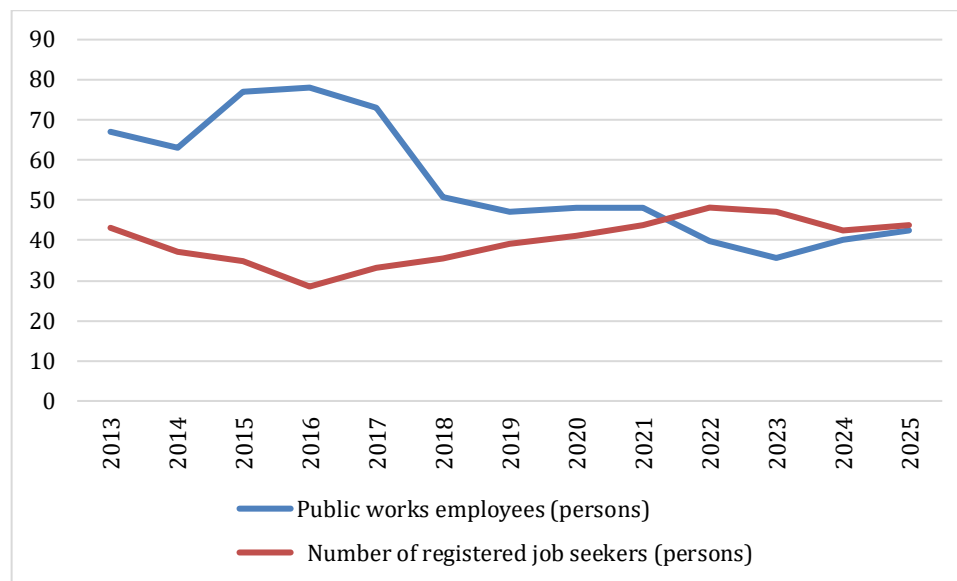


Figure 4. Number of public works employees in the municipality of Szemere from 2013 to 2023

Source: www.kozfoglalkoztats.bm.hu

The above diagrams clearly show that in recent years, the number of participants in public employment in the settlement has been declining. It can be observed that in 2016 the number of people working in this form was nearly twice as high as in recent years.

Within the framework of the Start Work agricultural public employment program, pigs and chickens are raised locally, and grain crops (wheat, barley, and corn) are cultivated to feed the animals. The piglets are sold, while the eggs produced through poultry farming are used in the municipality's kitchen for public catering, with some also being sold.

Public employees are also responsible for maintaining the settlement, including keeping public spaces and parks clean and contributing to the creation of a well-maintained and orderly village environment. Within the Start Work pilot program, a cold storage facility was built, and the old granary building was renovated, which is currently used by the Social Cooperative.

Additional employment opportunities are quite limited for the local population. Approximately 6–8 people commute to work at Robert Bosch Power Tool Kft. in Miskolc using a company minibus. Others work in the local shop, at the forestry service, or at Borsod Volán.

The primary objective of social cooperatives is to create employment opportunities for disadvantaged individuals and to contribute to improving their social conditions through various means. In most cases, operating cooperatives are established through bottom-up initiatives. Social cooperatives organized on the foundations of public employment are typically engaged mainly in agricultural production, food processing, the production of local products, and the provision of services.

The concept of the Start Social Cooperative emerged around 2019. It is important to note that, in addition to the regulations governing social cooperatives, a municipality classified as a public employer must participate both in the establishment and in the operation of such cooperatives. Furthermore, among the founders, there must be at least one individual who is employed by the municipality within the public employment system, that is, a public worker.

The Kánásalja Social Cooperative operating in Szemere was established on April 4, 2015, and by the end of 2019, it was renamed the Kánásalja Economic and Service Start Social Cooperative. The cooperative's main activities include the cultivation of cereals, apples, grapes, spices, and medicinal herbs, animal husbandry, meat processing, fruit juice production, food trade, as well as construction and demolition activities.

The Start Social Cooperative operating in Szemere employed four people for several years; currently, two young men are employed under simplified employment contracts (daily registration). They produce 100 per cent fruit juice without preservatives for the cooperative, which is then sold to public catering services. They also produce fruit juice under contract manufacturing and undertake smaller construction works, for which they receive wages higher than those in public employment. The cooperative's revenue currently just covers its expenses.

5. Conclusions

According to the mayor, there is unfortunately a high demand for public employment, as job seekers find it difficult to obtain employment in the labour market. The settlement is located in a rather remote area, far from the factories that are still operating, and commuting to these workplaces would not be feasible.

Public employment does not generate direct financial benefits for the settlement; however, it ensures that the village of Szemere and its cemetery are kept clean and well-maintained. Those employed in long-term public employment programs mow the grass, collect litter, and clear fallen leaves in the autumn. In other words, they are responsible for maintaining the settlement. They also renovate benches and waste containers. In addition, the municipality purchases flowers in the spring, which are planted and maintained throughout the village by public workers.

However, experience shows that each year the municipality receives less funding for operational costs. Beyond the expenses planned within the public employment programs, the municipality must continuously finance additional costs from its own resources. In many cases, they operate almost entirely from their own funds and receive only wage subsidies from the state.

For many residents, public employment programs provide their main source of livelihood. Adrienn also acknowledged that the wages these workers receive are very low, and that many of them can only survive with considerable financial hardship. She cannot imagine what would happen to these residents if public employment were to be discontinued, as this opportunity currently ensures their subsistence. Several participants in the program eventually transition from public employment into early retirement once they reach the age of 60.

She also noted that earlier public employment programs had significantly greater financial resources, allowing the purchase of high-value equipment. For example, the municipality was able to acquire industrial machinery for fruit juice production, which is still in use today. With the help of these resources, they were able to carry out several improvements that contributed to the development and beautification of the settlement.

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CROSS-BORDER ONLINE TRANSACTIONS A TOOL FOR ECONOMIC RESILIENCE DURING PANDEMIC CRISES: THEORETICAL PERSPECTIVES AND PRACTICAL STRATEGIES

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Abstract: The COVID-19 pandemic and similar global health crises exposed vulnerabilities in traditional economic systems, highlighting the urgent need for resilience strategies. Cross-border online transactions have emerged as a critical mechanism for sustaining economic activity during disruption. This paper explores the role of international digital commerce as a tool for economic resilience during pandemic crises, integrating theoretical frameworks and practical strategies. Drawing on economic resilience theory, digital innovation models, and crisis management literature, the study analyzes how online platforms enable businesses to maintain supply chains, access international markets, and adapt operational processes under restrictive conditions. Key factors influencing resilience include technological adoption, strategic flexibility, digital infrastructure, and regulatory compliance. The research identifies sustainable practices such as diversification of digital channels, investment in cybersecurity, and data-driven decision-making that support continuity and long-term competitiveness. Additionally, the paper examines case studies of small and medium enterprises (SMEs) and multinational corporations that leveraged cross-border online transactions to mitigate economic shocks, highlighting lessons learned and replicable strategies. By synthesizing theoretical insights with empirical evidence, the study contributes to understanding how digital commerce can reinforce economic stability and adaptability during unprecedented disruptions. The findings underscore the importance of integrating technological innovation with sustainable business practices to enhance resilience, offering practical guidance for policymakers, business leaders, and researchers aiming to strengthen economic systems in an increasingly digital and interconnected world.

Keywords: cross-border online transactions, economic resilience, pandemic crises, digital commerce, sustainable business practices, technological innovation.

Classification JEL: F14, F15, F23, O33.

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1. Introduction

Global pandemics constitute major disruptions to the global economy, significantly affecting international trade, supply chains, and labor markets. The COVID-19 crisis forced governments and businesses to identify alternative ways to sustain economic activity, as lockdowns, travel limitations, and logistical interruptions severely weakened traditional trade channels dependent on physical interaction and transportation. In this context, digital technologies became essential for maintaining economic operations. Cross-border online transactions, particularly through e-commerce platforms and digital marketplaces, enabled companies to continue participating in global markets despite mobility restrictions, maintain customer relationships, and adjust their business models to rapidly changing conditions.

Recent studies suggest that the growth of cross-border e-commerce strengthens export resilience by increasing efficiency, reducing transaction costs, and expanding access to international markets, while also facilitating the internationalization of small and medium-sized enterprises by lowering barriers such as geographic distance and information asymmetry. Accordingly, this study examines the role of cross-border online transactions as a mechanism for enhancing economic resilience during pandemic crises, combining theoretical insights from international economics and digital transformation with practical strategies that can support businesses and policymakers in managing future disruptions.

2. Literature Review

Digital trade and cross-border e-commerce have become crucial for sustaining business operations and international trade during global crises such as COVID-19. Research shows that these technologies enable firms to conduct remote transactions, access international markets, and adapt business models amid disruptions. Cross-border e-commerce enhances economic resilience by lowering transaction costs, streamlining trade chains, and improving operational efficiency. It also supports SMEs by maintaining continuity and expanding market reach, particularly in developing economies. Robust digital infrastructure and platform ecosystems further strengthen supply chain stability and coordination, while reducing barriers to internationalization. Overall, the literature highlights that cross-border online transactions are key to economic resilience, though more research is needed to clarify mechanisms and identify practical strategies for future crises.

3. Methodology

This study employs a mixed-methods approach to assess the role of cross-border online transactions in enhancing economic resilience during pandemic crises. It begins with a systematic literature review to synthesize existing research on cross-border e-commerce, digital trade, and resilience, using defined keywords and inclusion criteria across major scholarly databases. The second stage analyzes secondary quantitative and qualitative data, including e-commerce export volumes, digital payment adoption, trade flow changes, and case studies of firms and platforms that adapted during COVID-19. Combining these methods allows for a comprehensive evaluation of both theoretical mechanisms and practical outcomes, supporting evidence-based recommendations for businesses and policymakers to strengthen economic resilience in future crises.

4. Results and Discussion

Recent empirical studies indicate that cross-border e-commerce and online transactions have become pivotal in reinforcing economic resilience, particularly under the severe disruptions triggered by the COVID-19 pandemic and comparable global crises. Evidence from panel data analyses spanning multiple regions suggests that the growth and adoption of cross-border digital trade mechanisms allow firms to mitigate the vulnerabilities of traditional export systems. Specifically, the use of online platforms and digital marketplaces helps streamline trade operations by shortening supply and distribution chains, lowering the costs associated with conventional transactional processes, and increasing the overall speed and efficiency of cross-border exchanges.

These improvements in operational performance provide companies with greater stability in international markets, enabling them to sustain trade flows despite external shocks such as lockdowns, travel restrictions, or logistical interruptions. Furthermore, the research highlights that firms leveraging cross-border e-commerce are better positioned to adapt rapidly to changing market conditions, diversify their customer bases, and maintain continuous participation in global trade networks, thereby enhancing both short-term crisis management and long-term export resilience. In sum, these findings underscore the crucial role of digital commerce as a strategic tool for buffering economic systems against disruptions and for supporting sustained engagement in the international marketplace, even during periods of heightened uncertainty (Ning et. al., 2025).

For instance, empirical research based on data collected from various Chinese prefectures demonstrates that the development of cross-border e-commerce has a substantial positive impact on the resilience of export activities. The findings indicate that regions with a higher level of engagement in digital cross-border trade are better able to maintain stable export performance even in the presence of economic disruptions or external shocks. This increased resilience is largely attributed to the efficiency and flexibility provided by digital trading platforms, which enable firms to access international markets more directly and respond more rapidly to changes in demand and supply conditions.

Moreover, the study reveals that the presence of foreign direct investment (FDI) further strengthens this positive relationship. FDI contributes to the development of critical trade-supporting infrastructure by facilitating investments in modern logistics systems, including the establishment of overseas warehouses, advanced distribution networks, and the integration of intelligent technologies such as digital tracking systems and automated supply chain management tools. These investments improve the efficiency and reliability of cross-border trade operations, allowing exporters to reduce delivery times, optimize inventory management, and enhance their competitiveness in global markets. Consequently, the combined effect of cross-border e-commerce expansion and foreign direct investment creates a more robust and adaptable export system capable of withstanding economic instability and maintaining international trade flows during periods of crisis.

Further studies examining the impact of the digital economy on healthcare-related cross-border e-commerce highlight that the process of digitalization plays a critical role in strengthening the resilience of supply chains. By integrating digital technologies, firms and healthcare providers are able to reduce dependence on individual or single-source trade networks, which traditionally create vulnerabilities during periods of disruption. Digitalization also facilitates the adoption of more sophisticated and complex export technologies, enabling companies to diversify their production and distribution processes, improve logistics coordination, and better manage risks associated with international trade. Moreover, the establishment of pilot e-commerce zones has been shown to amplify these resilience benefits by providing controlled environments for testing and implementing digital infrastructure, innovative platforms, and automated systems, thereby supporting more efficient cross-border operations. Collectively, these measures enhance the capacity of healthcare supply chains to maintain continuity, adapt rapidly to unexpected challenges, and ensure consistent delivery of goods and services across global markets even during periods of crisis (Liu et. al., 2025).

Furthermore, the existing body of literature underscores that the expansion of cross-border e-commerce is closely linked to enhanced operational flexibility and broader diversification for

businesses, which is particularly beneficial for small and medium-sized enterprises (SMEs). By leveraging digital trade platforms, firms gain the ability to adjust their production, distribution, and marketing strategies more rapidly in response to sudden changes in market conditions, thereby preserving their competitive position even during periods of economic uncertainty. In addition, research emphasizes that the digitization of trade functions as a critical mediating mechanism: improvements in digital infrastructure, adoption of advanced technological systems, and streamlined online processes collectively bolster the resilience of both export operations and supply chains. These enhancements allow firms to optimize logistics, manage risks more effectively, and maintain stable engagement in international markets despite external shocks. As a result, the integration of digital technologies into cross-border trade not only supports short-term adaptability but also contributes to long-term structural resilience, enabling enterprises to respond dynamically to disruptions while sustaining growth and competitiveness in a rapidly evolving global economy.

Taken together, the evidence indicates that the growth and widespread adoption of digital commerce extends beyond merely ensuring the short-term continuity of international trade during periods of crisis; it also plays a crucial role in fostering long-term structural resilience within global economic systems. By enabling firms to operate more flexibly, streamline operations, and integrate digital processes into supply chains, cross-border e-commerce enhances overall adaptability in the face of external shocks.

Moreover, the efficiency gains achieved through digital transactions such as faster communication, reduced transaction costs, and improved coordination across logistics networks allow businesses to maintain stable international market participation even under adverse conditions. The integration of digital platforms further promotes interconnectedness among global markets, facilitating diversified trade relationships, mitigating dependencies on single trading partners, and strengthening the capacity of enterprises to absorb, respond to, and recover from disruptions. Consequently, the rise of digital commerce serves not only as a mechanism for immediate crisis management but also as a strategic tool for building more robust, efficient, and resilient global trade networks over the long term.

Economic resilience theory

Economic resilience is generally understood as the capacity of economic systems, institutions, and individual enterprises to absorb external shocks, adapt to disruptions, and recover effectively from crises, ensuring continuity and stability even under extreme conditions such as global pandemics. Within the context of public health emergencies, this resilience involves the ability to maintain production, trade, and overall economic activity despite restrictions on mobility, interruptions in traditional supply chains, and sudden fluctuations in consumer demand.

Recent studies on digitalization and resilience highlight that the adoption of digital technologies plays a critical role in strengthening these capacities. Tools such as remote transaction systems, virtual collaboration platforms, and data-driven decision-making mechanisms enable firms to sustain operations even when in-person activities are severely limited. Empirical evidence demonstrates that sectors and organizations with higher levels of digital integration experienced smaller declines in revenues during economic downturns linked to the COVID-19 pandemic, suggesting that digital adoption not only supports immediate operational continuity but also enhances firms' ability to absorb shocks, respond

flexibly to changing conditions, and maintain long-term competitiveness in an increasingly uncertain global environment (Copestake et. al., 2024).

In particular, the development and widespread use of cross-border e-commerce platforms significantly reduces firms' dependence on conventional trade infrastructure, which traditionally relies on physical distribution channels, intermediaries, and complex logistical networks. By leveraging digital marketplaces and online trading systems, companies gain greater operational flexibility and are able to react more quickly to changing economic circumstances. This adaptability is especially important during periods of disruption, such as global crises or market instability, when traditional trade mechanisms may become inefficient or temporarily unavailable. Through digital platforms, firms can maintain direct access to international customers, manage orders and payments electronically, and adjust their supply strategies in real time, which allows them to remain active in global markets even when external conditions are unfavorable.

Furthermore, research focusing on digital trade and supply-chain resilience indicates that digital platforms play an essential role in improving the coordination and efficiency of logistical and transactional processes across borders. These technologies facilitate better communication among suppliers, distributors, and customers, while also enabling more accurate tracking of goods, streamlined documentation, and faster transaction processing. At the same time, the use of digital systems reduces various operational barriers such as administrative complexity, information asymmetry, and high transaction costs that often hinder international trade. As a result, firms that integrate digital platforms into their cross-border operations are better equipped to manage disruptions, respond effectively to crises, and maintain the continuity and stability of their international economic activities (Cui & Yang, 2025).

Digital trade and cross-border e-commerce

Cross-border online transactions represent a significant dimension of contemporary digital trade and refer to the international exchange of goods or services that takes place through electronic platforms and digital marketplaces linking buyers and sellers from different countries. In this form of trade, commercial interactions are carried out through online environments where companies and consumers can negotiate, purchase, and deliver products or services without being limited by geographical boundaries. Such transactions operate within a sophisticated technological ecosystem that integrates multiple digital components, including secure electronic payment systems, international logistics and distribution networks, and advanced information and communication technologies. These technological elements collectively enable efficient coordination between producers, suppliers, distributors, and end users on a global scale.

The presence of this digital infrastructure significantly transforms the way international trade is conducted. By relying on electronic communication systems, real-time data exchange, and automated transaction processes, firms can manage cross-border operations more effectively and with fewer physical and administrative constraints compared to traditional trade models. As a result, digital trade facilitates faster interactions between market participants, improves transparency in transactions, and reduces the need for intermediaries in certain stages of the trade process. In a broader sense, digital trade encompasses commercial activities that are either digitally ordered, digitally delivered, or digitally enabled, illustrating a shift from conventional trading practices toward

technology-driven international exchanges that rely heavily on digital networks and data flows to complete transactions across borders (Gonzalez & Jouanjean, 2017).

Empirical studies provide substantial evidence that the expansion of cross-border e-commerce plays an important role in strengthening the resilience of export activities and improving the overall efficiency of international trade systems. Research findings indicate that the increasing use of digital platforms for international commercial exchanges allows firms to overcome many of the limitations associated with traditional trade mechanisms. In particular, the development of online marketplaces and digital trade platforms contributes to the simplification of conventional trade structures by shortening supply and distribution chains and reducing the number of intermediaries typically involved in export transactions. This structural simplification leads to a reduction in transaction costs, administrative burdens, and operational expenses that are commonly associated with traditional export procedures.

Moreover, digital technologies facilitate faster and more transparent international trade processes. Through automated systems, real-time communication tools, and digital documentation, firms can manage orders, payments, and logistics more efficiently than in conventional trade models. These improvements enhance the coordination of international transactions and strengthen the reliability of global trade operations. As a result, companies are better equipped to maintain stable participation in foreign markets even during periods characterized by economic volatility, supply chain disruptions, or unexpected external shocks.

In addition, cross-border digital trade provides businesses with greater opportunities to diversify their market presence across multiple geographic regions. By accessing international consumers through online platforms, firms can reduce their dependence on a single export destination or regional market. This diversification strategy improves risk management and increases the ability of companies to respond flexibly to changes in global economic conditions. Consequently, the continued expansion of cross-border e-commerce not only supports the efficiency of international trade but also strengthens the long-term resilience and adaptability of export-oriented enterprises operating in an increasingly interconnected global economy (Wu et. al., 2024).

Technological innovation and digital transformation

Technological innovation represents a key driving force behind the development and expansion of cross-border digital transactions in the contemporary global economy. The continuous advancement and widespread integration of modern technologies such as artificial intelligence, big data analytics, blockchain applications, and sophisticated digital payment infrastructures, have profoundly reshaped the mechanisms through which international trade is organized and conducted. These technological solutions enable companies to handle large volumes of transactional and market data efficiently, automate numerous operational processes, and significantly improve the security, transparency, and reliability of financial exchanges that occur across national borders.

In particular, technologies based on artificial intelligence and big data analytics allow firms to collect, process, and interpret vast quantities of real-time information related to consumer behavior, market trends, and transaction dynamics. Through these capabilities, companies can enhance strategic decision-making, optimize supply and distribution processes, and improve the overall efficiency of their participation in global trade networks. At the same time, blockchain technology introduces decentralized and highly secure digital ledger systems that ensure transparency and traceability throughout the entire transaction process.

By recording transactions in a tamper-resistant and verifiable manner, blockchain reduces the risk of fraud, increases accountability, and strengthens the level of trust between international trading partners. Consequently, the integration of these advanced technological tools not only facilitates the growth of cross-border digital commerce but also contributes to building a more secure, efficient, and transparent environment for global economic interactions (Rahardja et. al., 2025).

In addition, the development of digital payment systems has significantly improved the efficiency and accessibility of financial settlements between buyers and sellers engaged in international trade. Unlike traditional payment methods, which often involve lengthy processing times, complex banking procedures, and multiple intermediaries, modern digital payment platforms enable transactions to be completed more quickly and with greater convenience. These systems allow companies and consumers to transfer funds across borders in real time or within very short processing periods, reducing delays that previously characterized international financial operations. Furthermore, digital payment solutions simplify administrative procedures by automating many aspects of transaction verification, documentation, and authorization, thereby minimizing bureaucratic obstacles and lowering the operational costs associated with conventional payment mechanisms.

As a result, businesses participating in cross-border trade can conduct financial exchanges more smoothly and efficiently, improving overall transaction reliability and strengthening confidence among international trading partners. When combined with other advanced technological tools such as artificial intelligence, blockchain technologies, and digital trade platforms digital payment systems contribute to the creation of a more integrated and technologically advanced commercial environment. This integrated digital ecosystem enhances the security, transparency, and efficiency of cross-border transactions, ultimately supporting the development of a more reliable and resilient framework for global digital commerce.

Beyond facilitating individual commercial transactions, digital transformation also plays a vital role in strengthening the resilience and stability of global supply chains. The integration of digital technologies into logistics systems, production planning, and operational management allows companies to coordinate more effectively with suppliers, transportation providers, distributors, and end consumers. Through the use of digital platforms, real-time data exchange, and automated management systems, firms are able to improve the flow of information across the entire supply chain network. This enhanced communication and data transparency enables better synchronization between production processes, inventory management, and distribution activities, ultimately increasing the efficiency and responsiveness of supply chain operations.

Furthermore, studies on the digital economy indicate that the expansion of digital technologies significantly reinforces cross-border supply chain performance. Digital infrastructures accelerate the movement of both information and resources between supply chain actors, allowing companies to respond more rapidly to fluctuations in demand or disruptions in supply. At the same time, digital systems help reduce information asymmetry among participants in the supply chain by providing accurate and accessible data regarding orders, inventory levels, delivery schedules, and market conditions. This improved transparency contributes to more efficient matching between supply and demand, minimizing delays, shortages, or overproduction (Liu et. al., 2025).

As a result, digital transformation supports the optimization of export structures by enabling firms to manage their international trade operations more strategically and efficiently. It also reduces operational vulnerabilities by increasing visibility and coordination throughout supply networks. Consequently, companies that adopt digital technologies are better equipped to maintain stable cross-border trade activities and sustain their participation in global markets, even during periods characterized by economic volatility, supply chain disruptions, or other forms of external uncertainty.

During the pandemic, widespread lockdown measures and public health restrictions significantly disrupted many traditional channels of international trade. Limitations on transportation, border closures, and reduced labor availability in manufacturing and logistics sectors created substantial obstacles for firms that relied on conventional distribution networks and physical retail operations. As a result, many businesses faced difficulties maintaining their normal trade activities and accessing foreign markets. In this context, cross-border online transactions emerged as a crucial alternative that enabled companies to sustain international sales despite the severe limitations imposed on physical commerce. By shifting their operations from traditional retail outlets to digital platforms and online marketplaces, firms were able to continue engaging with customers across national borders.

Digital marketplaces played a particularly important role in this transition by providing businesses with direct access to global consumers through online channels. These platforms allowed companies to showcase and sell their products internationally without requiring physical presence in foreign markets or reliance on traditional trade intermediaries. Even while travel restrictions and market closures limited conventional export activities, firms that adopted online sales channels could maintain their participation in international trade. Consequently, the expansion of cross-border digital commerce contributed to stabilizing global trade flows during the pandemic and helped mitigate some of the broader economic disruptions caused by the crisis.

Small and medium-sized enterprises (SMEs) were among the most vulnerable to the economic effects of pandemic-related disruptions. Because these firms typically have more limited financial resources, smaller distribution networks, and less diversified markets, they were particularly exposed to sudden declines in demand and interruptions in supply chains. Nevertheless, the growth of digital marketplaces created new opportunities for SMEs to access international markets more easily. Through online platforms, smaller businesses could promote their products to a global audience, reach new customers beyond their domestic markets, and maintain revenue streams even when local economic activity slowed.

Research indicates that digital platforms significantly improve the visibility of SMEs in international markets and help reduce many of the barriers traditionally associated with exporting, such as high marketing costs, limited distribution infrastructure, and difficulties in establishing international partnerships. By lowering these entry barriers, digital trade platforms facilitate the internationalization of smaller firms and strengthen their competitive position within the global economy. Moreover, by adopting cross-border digital sales channels, SMEs can diversify their customer base geographically, which reduces their dependence on a single local or regional market and increases their capacity to manage economic risks (Orman, 2024).

In addition to supporting market access and revenue generation, cross-border online transactions also contribute to strengthening the resilience of supply chains. Digital

platforms enable more efficient coordination among producers, distributors, logistics providers, and consumers by facilitating continuous communication and real-time data exchange. Through these digital systems, firms can track consumer demand patterns, adjust production volumes accordingly, and optimize their logistics and distribution strategies.

The integration of digital technologies into supply chain management improves operational efficiency and reduces the likelihood of disruptions. For instance, digital trade systems enhance supply chain transparency by allowing companies to monitor the movement of goods, track inventory levels, and identify potential bottlenecks within distribution networks. This improved visibility enables firms to respond quickly to changes in market conditions, shifts in consumer demand, or logistical challenges. As a result, digitalized supply chains are better equipped to maintain stable operations and ensure the continuity of cross-border trade even during periods of economic uncertainty or global crises.

Investment in digital infrastructure

Investing in digital infrastructure is widely recognized as a fundamental strategy for enhancing economic resilience, particularly in the context of cross-border online transactions and global digital commerce. Robust and reliable digital systems including high-speed internet connectivity, secure and efficient digital payment platforms, and integrated logistics and communication networks form the backbone that allows businesses to engage effectively in international trade. High-quality internet access facilitates real-time communication, data sharing, and transaction processing, while secure digital payment mechanisms ensure that financial exchanges across borders are fast, reliable, and protected from fraud. Together, these components reduce operational costs, improve efficiency, and make e-commerce and export activities more resilient to external shocks.

Empirical evidence suggests that countries with advanced digital infrastructure are better positioned to participate in global trade and integrate into international value chains. These technologies enhance coordination along supply chains, lower barriers to entry for businesses of all sizes, and allow firms particularly small and medium-sized enterprises (SMEs) to expand their market reach internationally. By streamlining logistics, improving transaction transparency, and facilitating seamless interactions between suppliers, distributors, and consumers, digital infrastructure directly contributes to the stability and adaptability of economic systems.

Despite these advantages, significant disparities in digital access persist, especially in developing and emerging economies. Limited connectivity, inadequate payment systems, and underdeveloped logistics networks can constrain a country's ability to fully leverage digital trade opportunities, reducing its economic resilience and capacity to withstand global disruptions. Addressing these challenges requires proactive policymaking: governments should prioritize the expansion of broadband networks, support the development of secure and interoperable digital payment platforms, and implement inclusive policies that reduce the digital divide. Such measures not only enhance the efficiency of cross-border transactions but also empower a broader range of firms to participate in the digital economy, ultimately strengthening the overall resilience, adaptability, and sustainability of national and global economic systems (Mirzaye & Mohiuddin, 2025).

Regulatory harmonization

Cross-border online transactions rely not only on advanced technologies but also on comprehensive and well-structured legal and regulatory frameworks that support international commerce while ensuring consumer protection, data privacy, and information security. Since digital trade inherently involves the transfer of sensitive data, financial assets, and legally binding electronic agreements across multiple national jurisdictions, differences in regulatory standards can create uncertainty and increase compliance burdens for businesses. Harmonizing these regulations across countries can therefore reduce legal ambiguity, lower operational costs, and enhance the efficiency and reliability of cross-border transactions.

Contemporary digital trade agreements, including those negotiated by the European Union with its trading partners, often incorporate explicit provisions covering electronic contracts, digital authentication methods such as e-signatures, safeguards against unwarranted restrictions on data flows, and measures designed to protect consumers and strengthen trust in online markets. By establishing these common legal standards, countries can create a more predictable and coherent regulatory environment that facilitates international digital commerce while minimizing the risk of conflicts between national laws. This harmonization not only promotes smoother trade operations but also encourages wider participation in cross-border digital markets by providing businesses and consumers with greater certainty and confidence in the legal validity and security of their transactions (Jütten, 2024).

At the global level, multilateral initiatives spearheaded by organizations such as the World Trade Organization aim to establish harmonized approaches that facilitate secure and efficient electronic transactions while ensuring the protection of personal and sensitive data. These efforts focus on creating regulatory frameworks that support paperless trade, enable seamless cross-border digital exchanges, and guarantee non-discriminatory access to data flows between countries. Beyond these broad international agreements, regional conventions and cooperative frameworks particularly those addressing cybersecurity, data protection, and digital governance play a critical role in aligning national laws and standards. By reducing regulatory fragmentation, these mechanisms help minimize legal and operational obstacles for businesses and consumers participating in cross-border e-commerce. As a result, digital trade actors can operate with greater certainty and efficiency, benefiting from interoperable legal environments that facilitate international commerce while upholding privacy, security, and trust in the digital marketplace (European Commission).

Given that regulatory inconsistencies continue to pose significant challenges for cross-border digital commerce, ongoing and coordinated international cooperation among governments, trade bodies, and standard-setting organizations is crucial to develop harmonized standards for digital payments, data governance, and electronic transactions. Establishing such common frameworks helps align national regulations, reducing legal uncertainty and compliance burdens for businesses operating internationally. Beyond facilitating smoother commercial operations, these collaborative efforts enhance consumer confidence by ensuring that transactions are secure, transparent, and legally protected. They also provide firms particularly those engaging in cross-border e-commerce with a more predictable and reliable environment, enabling them to participate more efficiently and competitively in the global digital economy. In essence, sustained international coordination serves as a cornerstone for building a resilient, secure, and integrated digital trade ecosystem that benefits both businesses and consumers worldwide (Khasru & Diepeveen, 2025).

5. Conclusions

Cross-border online transactions have become an important factor in strengthening economic resilience, especially during global crises. The COVID-19 pandemic demonstrated that digital commerce can help sustain international trade when traditional systems are disrupted. By using digital platforms, businesses were able to maintain cross-border sales, continue operations, and adjust supply chains to changing market conditions, which helped stabilize global trade and reduce economic losses.

Research shows that digital trade enhances resilience by lowering transaction costs, expanding access to international markets, and providing greater operational flexibility. Online platforms simplify communication, automate processes, and allow companies to connect directly with customers worldwide. These advantages improve export performance and make international trade more efficient and adaptable during economic shocks.

Cross-border e-commerce also supports small and medium-sized enterprises (SMEs) by reducing barriers to entering global markets. Digital marketplaces increase visibility, lower marketing and distribution costs, and enable SMEs to reach international customers more easily, improving their competitiveness and participation in global trade.

To strengthen resilience in the future, governments and businesses should invest in digital infrastructure, promote regulatory coordination, strengthen cybersecurity, and develop digital skills. By combining technological innovation with sustainable business strategies, cross-border online transactions can play a key role in building more adaptive and resilient economic systems in an increasingly digital global economy.

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DIGITALIZATION AND ARTIFICIAL INTELLIGENCE AS DRIVERS OF THE TRANSFORMATION OF THE GLOBAL WORKFORCE

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Abstract: *This paper examines how digitalization and artificial intelligence are transforming the global workforce, with particular attention to the interaction between automation, augmentation, new forms of work organization and the growing demand for digital competencies. The objective of the study is to synthesize recent evidence on labor-market restructuring and to identify the conditions under which artificial intelligence can support inclusive and sustainable workforce transformation. The research applies a qualitative, conceptual and comparative methodology based on secondary data from international reports, policy documents and specialized studies published by organizations such as the World Economic Forum, the International Labour Organization, the Organisation for Economic Co-operation and Development and selected professional research platforms. The findings indicate that digitalization and artificial intelligence accelerate the automation of routine tasks, but their broader economic effect depends on whether they are implemented as labor-substituting technologies or as tools for human capability augmentation. The analysis also shows that the transition is unevenly distributed across sectors, gender groups, age categories and national economies. Remote work, platform labor, algorithmic management and AI-enabled reskilling are becoming structural elements of the emerging labor market. The paper concludes that technological progress alone cannot guarantee inclusive development. Responsible governance, lifelong learning, portable social protection and institutional adaptation are essential for aligning digital innovation with human development and economic resilience.*

Keywords: *artificial intelligence, digitalization, global workforce, automation, augmentation, lifelong learning, social protection.*

Classification JEL: J24, O33, M54.

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1. Introduction

The global labor market is entering a phase of accelerated structural reconfiguration generated by the combined effects of digitalization, artificial intelligence (AI), demographic change, environmental transition and geopolitical fragmentation. Digitalization refers to the integration of digital technologies into economic and organizational processes, while AI refers to computational systems capable of performing tasks that normally require human cognitive functions, such as pattern recognition, language processing, prediction, reasoning and decision support. These technologies affect work not only by replacing selected activities, but also by redesigning business processes, changing the allocation of tasks between humans and machines, and modifying the competencies required from employees.

The relevance of this topic has increased substantially after the diffusion of generative artificial intelligence (GenAI) tools, AI assistants and AI agents in professional settings. Unlike earlier waves of automation, which were mainly associated with industrial machinery and routine physical processes, current AI systems are increasingly applied to cognitive, informational and service-based activities. Consequently, occupations in finance, accounting, legal services, education, healthcare, administration, marketing and software development are directly exposed to changes in work content and skill requirements. The World Economic Forum (2025) estimates that structural labor-market transformation will affect about 22% of current global employment by 2030, creating millions of new jobs while displacing a significant number of routine-based roles.

The central research problem addressed in this paper is the uneven and multidimensional nature of workforce transformation under digitalization and AI. On the one hand, these technologies can raise productivity, reduce repetitive work, create new occupations and support better decision-making. On the other hand, they can intensify labor-market polarization, increase pressure on workers, weaken traditional employment relations and deepen inequalities if the gains are captured unevenly. Therefore, the future of work should not be reduced to a deterministic debate about job destruction. It must be analyzed as a socio-economic process shaped by organizational choices, public policies, education systems, labor-market institutions and ethical governance frameworks.

The main objective of this article is to analyze digitalization and artificial intelligence as drivers of the transformation of the global workforce. The paper pursues four specific objectives: to synthesize the relevant academic and policy literature on automation, augmentation and digital labor-market restructuring; to explain the methodological approach used to compare evidence from different sources; to discuss major results concerning sectoral changes, social inequalities, platform work and skills adaptation; and to identify strategic directions for inclusive and human-centered workforce transformation. The research question guiding the analysis is: under what conditions can digitalization and artificial intelligence contribute to productive, resilient and socially inclusive labor-market transformation?

The originality of the paper lies in the integrated approach it adopts. Instead of treating AI only as a technological innovation or as a threat to employment, the analysis connects macroeconomic labor-market projections with task-level automation, sectoral reconfiguration, gender and age vulnerabilities, platform work, remote work, reskilling strategies and governance principles. This perspective is particularly relevant for economies that are attempting to modernize their labor markets while also protecting workers from new forms of insecurity. The paper is structured according to the academic requirements of the conference template: the introduction defines the problem and objectives; the literature review synthesizes the theoretical and empirical foundations; the methodology explains the research design; the results and discussion section presents the main analytical findings; and the conclusions summarize contributions, limitations and future research directions.

2. Literature Review

The literature on digital transformation and work has evolved from a narrow focus on technological substitution toward a broader analysis of task reallocation, human-machine complementarity and institutional adaptation. Classical automation theory emphasized the capacity of technology to replace routine labor. In this view, tasks that are codifiable,

repetitive and predictable are more likely to be automated, while tasks requiring creativity, complex communication, interpersonal judgment and contextual reasoning remain more resistant to substitution. The current AI wave modifies this distinction because GenAI and machine learning systems can now perform parts of cognitive work that were previously considered relatively protected.

The automation-augmentation distinction is central for understanding the contemporary workforce transformation. Automation occurs when a technology substitutes human labor in a specific task, such as invoice processing, basic data entry, fraud screening or standardized document generation. Augmentation occurs when technology increases the productivity or quality of human work by providing analytical support, summarizing information, generating alternatives, identifying patterns or assisting in decision-making. Wipfli (2026) emphasizes that organizations should distinguish between cost-reduction automation and capability-enhancing augmentation because the two approaches generate different consequences for workers, productivity and innovation.

Recent contributions also point to the importance of task-level exposure rather than occupational-level replacement. Goldman Sachs (2026) argues that the employment effect of AI depends on the share of tasks within an occupation that can be automated or assisted, the pace of adoption and the capacity of firms to reorganize production around the technology. This approach helps explain why an occupation may be highly exposed to AI while not necessarily disappearing. A lawyer, accountant, doctor, marketer or teacher may delegate selected informational tasks to AI tools while retaining professional judgment, client interaction, responsibility and strategic interpretation.

The World Economic Forum (2025) frames digitalization and AI within a wider set of labor-market megatrends. Its projections suggest that technological development, the green transition, demographic shifts and geoeconomic fragmentation will jointly transform employment structures by 2030. The report anticipates the creation of 170 million new jobs and the displacement of 92 million roles, resulting in a net increase of 78 million jobs. At the same time, approximately 39% of workers' core skills are expected to change. This evidence indicates that labor-market transformation is not simply a matter of job loss, but a process of occupational restructuring and skills renewal.

Another stream of literature focuses on productivity effects. The Law & Economics Center (2026) discusses the empirical evidence on AI, productivity and labor markets, including the idea of a productivity J-curve. According to this perspective, productivity gains from general-purpose technologies are often delayed because firms must first invest in intangible assets, such as employee training, data infrastructure, process redesign and organizational learning. Therefore, the impact of AI may appear limited in aggregate indicators during the early adoption phase, even when significant changes are already occurring at the level of tasks and workflows.

Sectoral literature shows that AI adoption varies considerably across industries. In healthcare, AI is increasingly applied to clinical documentation, disease detection, diagnosis support, training optimization and patient monitoring (National Center for Biotechnology Information, 2025; Boston Consulting Group, 2025). In finance and accounting, AI tools are used for audit review, cash-flow modelling, tax research, fraud detection, reconciliation and management reporting (Stanford Graduate School of Business, 2026). In legal services,

Thomson Reuters (2025) documents the increasing use of AI for legal research, contract analysis, document drafting and professional knowledge management.

The social dimension of the transition is also strongly represented in the literature. The International Labour Organization (2026a, 2026b) highlights that women face higher exposure to GenAI-related workplace risks because they are overrepresented in clerical and administrative occupations. This does not mean that women are inherently more vulnerable to technology; rather, vulnerability reflects the gendered structure of employment and the concentration of women in roles with high routine-task content. Similarly, early-career workers may face risks when AI systems substitute codified knowledge and routine entry-level tasks that traditionally functioned as training pathways.

Digitalization also affects employment relations through remote work, gig work and algorithmic management. Platform-based labor expands access to income opportunities and enables firms to access flexible global talent pools, but it often weakens social protection, increases dependence on opaque ranking systems and complicates worker classification. The literature on portable benefits argues that social protection should be attached to the worker rather than to a single employer, especially when individuals perform work across several platforms or projects (Ignite HCM, 2026). This approach is increasingly important for reconciling flexibility with security.

The governance literature emphasizes responsible AI, transparency and human oversight. The Organisation for Economic Co-operation and Development (2026) stresses the need for trustworthy AI systems that support inclusive growth and protect workers from discriminatory or opaque algorithmic decision-making. UNESCO's ethical framework and the European Union's AI-related regulatory initiatives also point toward the need for AI literacy, accountability and risk management. These discussions show that the labor-market impact of AI is not predetermined by technology itself; it depends on the institutional environment in which AI is designed, deployed and monitored.

Despite the richness of existing literature, several gaps remain. First, many analyses examine either productivity, employment displacement or ethical regulation separately, without integrating these dimensions into a single workforce transformation framework. Second, macro-level projections often do not fully explain how changes occur within sectors and occupations. Third, there is insufficient attention to the link between AI adoption, work organization, social protection and lifelong learning. This paper contributes to the debate by synthesizing these dimensions and presenting digitalization and AI as technological, organizational and institutional drivers of workforce transformation.

3. Methodology

This study uses a qualitative, conceptual and comparative research design. The purpose is not to estimate a new econometric relationship, but to synthesize existing evidence and construct an integrated analytical interpretation of workforce transformation under digitalization and artificial intelligence. The research design is appropriate because the phenomenon analyzed is multidimensional, rapidly evolving and documented across different types of sources, including international reports, policy documents, professional studies and academic contributions.

The data used in the paper are secondary. The main sources include reports and studies published by the World Economic Forum, the International Labour Organization, the Organisation for Economic Co-operation and Development, Goldman Sachs, Thomson Reuters, Stanford Graduate School of Business, the National Center for Biotechnology Information and other specialized organizations. The selection of sources followed three criteria: relevance to digitalization and AI in the labor market; empirical or conceptual value for understanding work transformation; and recency, especially for evidence published between 2024 and 2026. Earlier sources were used only when they provided conceptual support for the analysis.

The analytical procedure involved four stages. First, the available evidence was grouped into thematic categories: macroeconomic workforce transformation, automation and augmentation, sectoral reconfiguration, social inequalities, new forms of work organization, skills adaptation and governance. Second, the main quantitative indicators reported in the selected sources were extracted and compared, including projected job creation and displacement, skills transformation, AI exposure by gender, remote work trends and examples of sectoral productivity gains. Third, the evidence was interpreted through the automation-augmentation framework in order to distinguish between labor substitution and human capability enhancement. Fourth, the findings were synthesized into strategic implications for employers, education systems and policymakers.

The central analytical variables used in the study are digitalization, artificial intelligence adoption, task automation, task augmentation, workforce transformation, skill change and labor-market resilience. Digitalization is interpreted as the use of digital infrastructure, data-based processes and platform technologies in work organization. AI adoption refers to the deployment of machine learning, GenAI, AI assistants and AI agents in professional processes. Task automation is defined as the machine execution of repetitive or rules-based activities, while task augmentation refers to AI-supported improvement of human decision-making and productivity. Workforce transformation refers to changes in employment structure, occupational content, skills demand, work organization and social protection needs.

Several methodological limitations must be acknowledged. The study relies on secondary sources and does not include original survey data, interviews or firm-level observations. The evidence is also heterogeneous because international organizations and professional platforms use different methodologies, definitions and geographic coverage. Moreover, projections related to AI adoption are inherently uncertain because technological capabilities, regulation, business models and social responses continue to evolve. To address these limitations, the paper avoids deterministic claims and uses the evidence as a basis for conceptual synthesis rather than precise prediction.

4. Results and Discussion

The analysis confirms that digitalization and artificial intelligence are not isolated technological trends, but structural forces reshaping the global labor market. The most visible effect is labor-market churn: the simultaneous creation, transformation and displacement of jobs. According to the World Economic Forum (2025), 170 million jobs may be created by 2030, while 92 million roles may be displaced. This results in a projected net increase of 78 million jobs, but the aggregate positive balance does not eliminate the

adjustment costs faced by workers, firms and education systems. Table 1 summarizes the main structural projections used in the analysis.

Table 1. Structural labor-market projections for 2025-2030

Indicator	Projection / finding	Interpretation
New jobs created	170 million	Expansion of roles linked to technology, green transition, care economy and new services
Jobs displaced	92 million	Reduction of routine, clerical and repetitive work
Net employment increase	78 million	Positive aggregate effect, accompanied by significant occupational reallocation
Core skills expected to change	39%	High need for reskilling and upskilling
Current employment affected by churn	22%	Transformation of tasks, occupations and work organization

Source: Authors' synthesis based on World Economic Forum (2025).

The figures in Table 1 show that the main challenge is not only the number of jobs created or displaced, but the speed and distribution of change. A net positive employment balance can coexist with severe difficulties for workers whose competencies become obsolete or whose occupations are reorganized. This is particularly important for education systems and enterprises because the anticipated transformation of 39% of core skills implies that initial professional training will no longer be sufficient for long-term employability. Labor-market resilience will depend on the capacity to build continuous learning systems, career transition mechanisms and organizational cultures that support adaptation.

The second major result concerns the distinction between automation and augmentation. The same AI technology can be deployed in two very different ways. If implemented primarily to reduce labor costs, AI may replace routine activities and intensify employment insecurity. If implemented as a complementary tool, it can improve the quality of human work, reduce repetitive burden and increase the capacity of workers to focus on complex tasks. This distinction is essential because it shifts the debate from whether AI will eliminate jobs to how AI is integrated into work design. Table 2 presents the main differences between the two approaches.

Table 2. Automation and augmentation as alternative AI deployment logics

Dimension	Automation logic	Augmentation logic
Primary objective	Cost reduction, speed and error minimization	Decision quality, creativity, productivity and service improvement
Main task type	Repetitive, rules-based, high-frequency processes	Analytical, judgment-based, relational and creative processes
Human role	Monitoring, exception handling and compliance	Interpretation, critical thinking, empathy and strategic direction
Workforce effect	Potential substitution of labor	Complementarity between workers and technology
Examples	Invoice processing, spam filtering, routine data entry	Clinical decision support, legal research, financial analysis, marketing content planning

Source: Authors' synthesis based on Wipfli (2026) and Goldman Sachs (2026).

The automation-augmentation spectrum also clarifies why occupational exposure should not be confused with occupational disappearance. Many professional roles include a combination of routine and non-routine tasks. For example, accountants may use AI to automate reconciliation and reporting, but still perform interpretation, client communication, risk assessment and strategic advisory functions. Lawyers may automate document search or contract review while retaining responsibility for legal reasoning and client advocacy. Physicians may use AI for documentation or diagnostic support, but clinical responsibility and patient trust remain strongly human-centered. Therefore, the most sustainable model is not the elimination of professionals, but the redesign of professional work around higher-value activities.

From a productivity perspective, the study supports the idea that AI effects may be delayed. The initial adoption of AI requires investment in data infrastructure, cybersecurity, workflow redesign, training and change management. As a result, firms may experience transitional costs before measurable productivity gains appear. This corresponds to the productivity J-curve described in the literature on general-purpose technologies. The implication is that organizations should not evaluate AI only through immediate cost reduction. They should also measure improvements in decision-making quality, time allocation, customer experience, knowledge management and innovation capacity.

The production logic behind AI-enabled productivity can be expressed through the general production function, where output depends on capital, labor and total factor productivity. In this framework, AI increases output not only by replacing some labor inputs, but by raising the efficiency with which labor and capital are combined:

$$Y = A * f(K, L) \quad (1)$$

In Equation (1), Y represents output, K represents capital, L represents labor, and A represents total factor productivity. AI adoption can increase A by improving information processing, prediction, coordination and the allocation of resources. However, this effect is not automatic. If workers are not trained, if data quality is poor, if processes are not redesigned or if employees distrust the technology, the productivity gain may remain limited. Therefore, AI productivity is both technological and organizational.

Sectoral analysis confirms that workforce transformation differs across industries. In healthcare, AI is used for notetaking, clinical training, disease detection, diagnosis and treatment support. The most important value of AI in this sector is not the replacement of physicians, but the reduction of administrative burden and the enhancement of clinical decision-making. AI-powered tools can process large volumes of patient data, support early detection and assist in personalized care. At the same time, the sector requires strict ethical governance because errors, bias and lack of transparency can directly affect human life and patient trust.

In finance and accounting, AI contributes to real-time precision, faster reporting and more analytical use of financial data. Routine tasks such as reconciliation, document review and transaction classification are highly suitable for automation. However, this does not necessarily eliminate accounting work. Instead, it changes the professional profile from transactional processing toward advisory, interpretation and risk management. The evidence from professional studies suggests that GenAI can shorten reporting cycles and improve the granularity of financial analysis. Table 3 summarizes major examples of AI-enabled sectoral reconfiguration.

Table 3. Examples of AI-enabled sectoral reconfiguration

Sector	AI applications	Main workforce implication
Healthcare	Clinical documentation, disease detection, diagnosis support, patient monitoring	Reduction of administrative burden and enhancement of professional judgment
Finance and accounting	Audit review, cash-flow modelling, tax research, fraud detection, reporting automation	Shift from routine processing to strategic advisory and analytical interpretation
Legal services	Legal research, contract analysis, document drafting, predictive analytics	Reallocation of time from administrative tasks to client advocacy and complex reasoning
Marketing and business services	Content generation, customer segmentation, analytics, campaign optimization	Higher demand for AI literacy, creativity, ethical communication and data interpretation
Education and training	Personalized learning, automated feedback, skills diagnostics, micro-learning platforms	Need to redesign pedagogy around human mentoring and AI-supported learning

Source: Authors' synthesis based on National Center for Biotechnology Information (2025), Boston Consulting Group (2025), Stanford Graduate School of Business (2026), Thomson Reuters (2025) and Agility at Scale (2026).

In legal services, the adoption of AI is creating a visible gap between organizations that develop explicit AI strategies and those that delay adoption. AI systems can accelerate legal research, compare documents, identify relevant precedents and support the drafting of standardized legal texts. Nevertheless, legal work remains dependent on interpretation, responsibility, professional ethics and client-specific judgment. The more advanced implication is that AI may compress the skill ladder in some occupations by enabling junior professionals to perform complex informational tasks earlier in their careers. This can democratize access to high-value work, but it can also reduce traditional entry-level learning opportunities if firms decrease junior hiring.

The social distribution of AI effects is a critical result of the analysis. The benefits and risks of digital transformation are not evenly distributed across the workforce. Gender is one important dimension. ILO evidence shows that women face higher exposure to GenAI-related risks because they are concentrated in clerical and administrative roles. Age is another dimension: early-career workers may be more exposed when AI automates codified knowledge and routine tasks that usually help young professionals acquire experience. Geography also matters because low-income economies may experience displacement risks before they receive the productivity benefits of AI augmentation, especially when digital infrastructure is insufficient.

These inequalities show that technological progress does not automatically produce inclusive development. Without targeted policies, AI may intensify existing social and economic asymmetries. Gender-responsive reskilling programs, support for early-career transitions, investment in digital infrastructure and access to lifelong learning are therefore necessary. The policy challenge is not only to prepare workers for new jobs, but also to protect the training pathways through which workers develop expertise. If AI replaces the junior tasks that previously served as learning opportunities, organizations must design new apprenticeship and mentoring models adapted to AI-enabled workplaces.

Digitalization also transforms the spatial and contractual organization of work. Remote work has become a permanent structural component in many sectors, supported by cloud technologies, digital collaboration tools and cybersecurity systems. Remote work expands access to global talent and can improve flexibility, but it also requires new management practices and legal frameworks. Cross-border hiring, digital monitoring and international payroll compliance create complex organizational responsibilities. For emerging economies, remote work may create opportunities to participate in global service markets, provided that digital connectivity, language skills and professional competencies are developed.

The gig economy and platform work represent another major organizational shift. Platformization allows firms to access flexible labor without maintaining traditional employment structures. For workers, it can provide income opportunities, autonomy and access to international demand. However, platform work often involves fragmented income, lack of benefits, dependence on algorithmic ratings and limited possibilities to contest decisions. The expansion of gig work into professional services, including IT, finance, marketing and consulting, shows that platform labor is no longer limited to low-skill delivery activities. The resulting labor model requires new forms of social protection and algorithmic accountability.

Portable benefits are one proposed solution to the instability of platform work. In traditional employment, health insurance, pensions and unemployment protection are usually connected to the employer. In flexible work arrangements, this model becomes insufficient because workers may move across several platforms, clients and projects. Portable benefits attach social protection to the worker, allowing contributions to accumulate across different income sources. This approach could reconcile flexibility with security if supported by clear legal rules, platform contributions, worker ownership and transparent governance. Table 4 summarizes the main elements of a human-centered workforce adaptation framework.

Table 4. Human-centered framework for workforce adaptation in the AI economy

Area of intervention	Key problem	Strategic response
Skills and education	Rapid obsolescence of routine skills	AI literacy, lifelong learning, role-specific reskilling and micro-credentials
Work organization	Fragmented employment and remote coordination	Flexible but transparent management models, digital collaboration norms and cybersecurity readiness
Social protection	Benefits tied to traditional employment contracts	Portable benefits, universal social protection floors and worker-owned accounts
Governance	Opaque algorithmic management and discriminatory risks	Human oversight, algorithmic transparency, accountability and ethical AI standards
Inclusion	Gender, age and geographic disparities	Targeted reskilling, digital infrastructure investment and inclusive access to AI tools

Source: Authors' synthesis based on International Labour Organization (2026a, 2026b), Organisation for Economic Co-operation and Development (2026), Ignite HCM (2026) and Agility at Scale (2026).

The framework in Table 4 emphasizes that workforce transformation requires coordinated action across several institutional domains. Skills development is essential, but it cannot operate in isolation. If employees receive AI training while performance indicators, job descriptions and promotion systems remain unchanged, adoption will likely remain

superficial. Similarly, platform workers cannot benefit from digital flexibility if they lack basic social protection and transparency regarding algorithmic decisions. Therefore, labor-market adaptation requires alignment between technology adoption, education, regulation, organizational leadership and social policy.

Reskilling and upskilling are among the most urgent strategic priorities. Upskilling refers to improving skills within an existing role, while reskilling refers to preparing workers for new roles. In the AI economy, upskilling includes AI literacy, prompt formulation, data interpretation, ethical awareness and the ability to critically evaluate AI outputs. Reskilling may involve transitions from administrative functions to AI operations, from routine reporting to data analysis, or from traditional service delivery to digital customer experience management. Effective programs must be continuous, personalized and embedded in work processes rather than limited to occasional training sessions.

The role of education systems is particularly important. Universities, vocational institutions and corporate training providers must update curricula in response to changing labor-market demand. This does not mean replacing disciplinary knowledge with technical tool training. On the contrary, AI increases the value of critical thinking, ethics, communication, problem framing, creativity and contextual judgment. Graduates must understand not only how to use AI tools, but also how to question their outputs, identify bias, protect data and integrate technological assistance into professional decision-making. Education systems should therefore combine digital competencies with humanistic and analytical capabilities.

Governance is the final and perhaps most decisive dimension. Responsible AI deployment requires clear standards for transparency, accountability, data protection, non-discrimination and human oversight. Algorithmic management systems should not be allowed to determine pay, work allocation, evaluation or dismissal without explainability and appeal mechanisms. AI literacy should be promoted not only among technical specialists, but also among managers, policymakers, workers and students. In this sense, regulation is not an obstacle to innovation; it is a condition for trust, legitimacy and sustainable adoption.

The findings of this paper partially confirm the optimistic view that AI can create productivity gains and new occupational opportunities. However, they also challenge overly simplified narratives that treat technology as a neutral force. Digitalization and AI generate outcomes through social systems. Their effects depend on who controls the technology, how work is redesigned, whether workers participate in adaptation, whether institutions protect vulnerable groups and whether education systems can respond quickly. The most productive and socially legitimate transition will be one in which AI supports human capability rather than replacing human value.

For enterprises, the practical implications are clear. Firms should begin with task analysis rather than broad occupational assumptions, identifying which activities should be automated, which should be augmented and which should remain human-centered. They should involve employees in workflow redesign, provide continuous training, revise performance indicators and establish clear rules for responsible AI use. For policymakers, the implications include investing in digital infrastructure, supporting lifelong learning, modernizing labor law for platform work and ensuring that social protection systems remain effective in flexible labor markets. For researchers, the findings suggest the need for more empirical work on AI adoption at firm level and on the quality of emerging jobs.

5. Conclusions

This paper analyzed digitalization and artificial intelligence as drivers of the transformation of the global workforce. The main conclusion is that the future of work cannot be explained through a simple substitution narrative. AI does automate selected tasks, especially repetitive and rules-based activities, but it also augments human capabilities when used to improve decision-making, reduce low-value work and support creativity, analysis and professional judgment. The key issue is therefore not whether AI will transform work, but how this transformation will be designed, governed and distributed.

The research contributes to the academic debate by integrating several dimensions that are often studied separately: macroeconomic labor-market churn, task-level automation and augmentation, sectoral reconfiguration, inequalities, platform work, remote work, reskilling and governance. This integrated perspective shows that digital transformation is a technological, organizational and institutional process. Productivity gains depend not only on software or algorithms, but also on training, data quality, leadership, trust, regulatory clarity and worker participation.

The findings indicate that sectors such as healthcare, finance, accounting, legal services, marketing and education are being reconfigured through AI-supported workflows. In these sectors, the greatest value appears where technology complements human expertise rather than eliminates it. At the same time, the transition creates risks for workers concentrated in routine administrative functions, women overrepresented in exposed occupations, early-career workers dependent on entry-level learning tasks and economies with insufficient digital infrastructure. These risks confirm that inclusion must be built deliberately into workforce transformation strategies.

The paper also concludes that new forms of work organization require new institutional responses. Remote work, platform labor and algorithmic management are becoming structural components of the digital economy. They offer flexibility and access to global opportunities, but they also create challenges related to surveillance, fragmented income, weak social protection and limited transparency. Portable benefits, universal social protection floors, algorithmic accountability and clear labor standards are necessary to ensure that flexibility does not become insecurity.

The study has several limitations. It is based on secondary sources and conceptual synthesis rather than primary empirical data. It does not test causal relationships econometrically and does not focus on one national labor market or one sector in depth. Moreover, the speed of AI development means that current projections may change as regulation, adoption patterns and technological capabilities evolve. Future research should therefore include comparative country studies, firm-level case studies, employee surveys and longitudinal analyses of how AI affects employment quality, career progression, income distribution and social inequality.

In conclusion, digitalization and artificial intelligence can become drivers of productivity, resilience and better-quality work if they are guided by inclusive policies and human-centered governance. If left unmanaged, they may deepen segmentation, insecurity and unequal access to opportunity. The path toward 2030 will be shaped not only by technological innovation, but also by the capacity of societies, organizations and education systems to align innovation with human development.

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LEADERSHIP, TEACHER AUTONOMY, AND FLOW, AS MICRO-FOUNDATIONS OF ORGANIZATIONAL RESILIENCE IN EDUCATION

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Abstract: *In a world defined by constant systemic change, schools need stability and the capacity to transform, if they want to remain functional and relevant. While there is a lot of research on organizational resilience, more attention should be given to the micro-level foundations within educational settings. This conceptual paper argues that the principals' leadership styles can foster teacher autonomy and flow, contributing to transformative organizational resilience. Teachers' decisions in the classroom, the ongoing adjustments of educational strategies, and their ability to focus and adapt support the school's ability to build on organizational resilience allowing educational institutions to adapt effectively to change. Recurrent adaptive practices at the classroom level may strengthen the school's overall capacity for transformation, creating conditions that support students' resilience. This paper proposes a conceptual model linking selected leadership styles, teacher autonomy, flow, and organizational resilience, in order to offer a management-oriented perspective on adaptive capacity in education.*

Keywords: organizational resilience, leadership, teacher autonomy, flow, educational management.

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1. Introduction

Change has become the biggest constant in schools (Heenan et al., 2024), influencing both how they function internally and how they respond to external demands. Any organizational change involves uncertainty and risk and educational leaders are expected to manage these challenges and support implementation processes (Issah, 2018). At the same time, society expects schools to prepare individuals who can function in rapidly changing environments. As a result, educational institutions need to continuously adapt (Bush, 2021), and their improvement depends on their ability to manage change effectively (Muijs & Harris, 2003) and to encourage teachers to take on leadership roles (Danielson, 2007). Teachers play a key role in this process, acting as catalysts for change (Harris, 2005) and contributing to the school's capacity for improvement (Chan, 2019).

Research shows that leadership is essential in shaping these dynamics. The quality of leadership styles influences both organizational performance (Anderson, 2017) and students' learning outcomes (Kilinç, 2014). However, educational leadership is no longer seen as hierarchical. It is understood as relational, collective, and purposeful, based on human interactions (Burns, 2012), vital in educational settings (Asbill & Gonzalez, 2022), where

the climate influences group performance (Goleman, 2016). Invitational leadership (IL) aims to create collaborative schools, based on relationships and growth (Purkey & Stanley, 1991; Purkey & Novak, 2015; Asbill & Gonzalez, 2022). When principals assume this leadership style, they create a learning ecosystem where every individual is seen, appreciated, and involved (Legros & Ryan, 2015). There is also a growing need for more inclusive leadership approaches that respond to the specific challenges of each school (El Mahzani et al., 2025), and educational leaders should adapt their strategies to respond to the unique challenges of every school (Dagala et al., 2024). Transformational leadership (TL) supports the development of a positive school culture, promoting student learning, and increasing teacher satisfaction (Sasan et al., 2023). TL is associated with mutual stimulation and elevation (Burns, 2012), shared visions, new ideas, and distributed responsibility (Yang, 2013).

Despite the strong focus on leadership, organizational resilience in schools cannot be explained only by leadership styles or policies. It is often defined as the ability to maintain positive functioning in challenging conditions (Sutcliffe & Vogus, 2003), but there is still limited research on what happens at the micro level, in classrooms, where learning actually takes place. Learning contributes to organizational resilience (Evenseth et al., 2022), yet teachers face diverse and changing situations that require constant adaptation. Since there is no single best way to design classroom practices (Pintrich, 2003), teachers must rely on their professional judgment to respond to the needs of their students. This suggests that organizational resilience may emerge from teachers' everyday work. At this micro level, teachers continuously adjust their strategies in response to the classroom complexity, in order to support and foster learning. Teacher autonomy allows for context-based decision-making, while the psychological state of flow supports sustained engagement and effective responses to challenges.

Teachers are seen as a “sleeping giant” (Katzenmeyer & Moller, 2011, p. 4) in every school and they can be awaked if schools create a culture where teacher leadership is appreciated (Katzenmeyer & Moller, 2011). Distributed leadership (DL) is positively associated with leadership support, empowerment, job satisfaction, and work performance (Harris, 2005; Kamaruzaman et al., 2020; Phillips et al., 2023; Tucaliuc et al., 2025). Moreover, DL encourages collaborative learning communities, whose result is school performance, fostering student academic performance (Harris, 2003).

This article adopts a conceptual perspective to explore how leadership styles, namely TL, DL, and IL, teacher autonomy, and flow interact as micro-level mechanisms that contribute to organizational resilience in educational settings. By focusing on these micro-level processes, the paper aims to offer an insight of how schools develop and sustain their capacity to adapt to change, since change in school capacity is positively related to student learning (Li & Liu, 2020). The paper is structured as follows: the next section reviews the relevant literature on TL, DL, and IL, autonomy, flow, and organizational resilience, followed by the methodology and concluding remarks.

2. Literature Review

Leadership in Educational Settings

School principals play an important role in creating environments that encourage resilience and engagement (Colignon et al., 2024) and school performance depends on the principal's

leadership style (Legros & Ryan, 2015; Labelle & Jacquin, 2018). The leadership approach encourages innovation and change (El Mahzani et al., 2025), gathering teachers around a shared vision (Labelle & Jacquin, 2018). According to Tony Bush, 2021, management should be orientated towards realizing goals, but these should be approved by the school and the community (Bush, 2021). Schools' goals and objectives are not determined locally, but from a different perspective (Fitzgerald & Gunter, 2008). Principals should identify the leadership style that best suits their school's needs (Legros & Ryan, 2015), since leadership is critical to innovation in schools (Spillane et al., 2004), and a clear vision has the potential to lead to school development (Bush, 2021). Hence the leader becomes the pillar that ensures cohesion and fosters vision (Le Saget, 1999), in response to the changing needs of the educational context (Hallinger, 2003).

Transformational leadership (TL), first formulated by Bass (Yukl, 1999; Yang, 2013; El Mahzani et al., 2025) and conceptually introduced by James MacGregor Burns (Covey, 2007; Burns, 2012; Anderson, 2017; Li & Liu, 2020), is recognized as a leadership style that inspires and mobilizes individuals toward shared goals (Leithwood & Jantzi, 1999; Sasan et al., 2023). It is characterized by influence and authority (Leithwood & Jantzi, 1999), vision, intellectual stimulation, respect, innovation, and motivation (Leithwood & Jantzi, 1999; Yukl, 1999; Pounder, 2005; Dagala et al., 2024; Kilag et al., 2024; Jobir, 2025), while also emphasizing emotions, values, and human-centered interactions (Yukl, 1999; Heenan et al., 2024).

The core dimensions of TL, often described as the four I's are idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration (Bass & Avolio, 1993; Sasan et al., 2023). TL is the most appropriate leadership style for today's schools (Anderson, 2017), as it impacts student achievement through creating a positive school culture (Quin et al., 2015). TL tries to understand students' needs, fostering motivation (Burns, 2012; Sasan et al., 2023; Dagala et al., 2024; Khoudri, 2024) and also a culture of creative change and growth (Bass & Avolio, 1993; Li & Liu, 2020), paying close attention to every employee (Yang, 2013). It inspires "wholeness of being" (Covey, 2007, p. 10), as it is human-centered (Heenan et al., 2024) and it promotes integrity and authenticity (Covey, 2007).

In educational settings, TL creates a supportive environment (Sasan et al., 2023; Khoudri, 2024) that empowers teachers to innovate, collaborate, and actively contribute to learning processes (Kilag et al., 2024; Jobir, 2025). It is associated with teacher commitment, job satisfaction, and performance (Anderson, 2017), while also fostering a learning climate oriented toward academic development and skill formation (Jobir, 2025). By encouraging shared vision, distributed responsibility, and the recognition of each individual's contribution (Bass & Avolio, 1993; Yang, 2013), TL strengthens both motivation and collaboration within the school, responding to the needs of students and supporting their motivation and engagement (Burns, 2012; Sasan et al., 2023; Dagala et al., 2024; Khoudri, 2024).

TL is particularly relevant in today's educational context, characterized by continuous change, as it enables leaders to adapt (Heenan et al., 2024) and it builds a sense of community and a positive school culture (Sasan et al., 2023). By inspiring purpose and shared values, leaders bring together the school community in pursuit of common goals (Allen et al., 2015; Dagala et al., 2024) contributing to both teacher satisfaction and student achievement (Allen et al., 2015). Moreover, TL supports the development of organizational capacities such as innovation and adaptability (Hallinger, 2003). It empowers collaboration and motivation, creating a school vision and mission (Leithwood & Jantzi, 1999; Anderson, 2017; Sasan et al., 2023; Heenan et al., 2024), where everyone has a unique contribution to make (Bass &

Avolio, 1993). In this perspective, TL can be seen not only as a driver of performance, but also as a foundation for organizational resilience. By fostering trust, collaboration, motivation, and innovation (Bass & Avolio, 1993; Li & Liu, 2020; Sasan et al., 2023; Khoudri, 2024), it creates the conditions through which schools can respond to challenges, sustain their functioning.

Distributed leadership (DL) is positively associated with leadership support, empowerment, job satisfaction, and work performance (Harris, 2003; Harris, 2005; Kamaruzaman et al., 2020; Phillips et al., 2023; Tucaliuc et al., 2025). It is viewed as a necessary alternative, since the principals' expertise is limited. Therefore, leadership should be distributed within the school (Danielson, 2007; Helterbran, 2016). In this sense, DL promotes a flexible and network-based structure (Le Saget, 1999), where values, responsibilities, and decision-making processes are collectively distributed. This shared approach fosters collaboration and professional learning, which in turn contributes to improved student outcomes (Harris, 2003) and organizational performance.

Within distributed leadership structures, teachers become active participants in school development, contributing to management decisions and influencing pedagogical practice within their professional communities (Le Saget, 1999; Harris, 2005). DL is a vital framework for addressing the complexity of modern education (Phillips et al., 2023), allowing every teacher to contribute to the school's growth and change (Kamaruzaman et al., 2020), thus leaving behind the belief that teachers are just teachers, which represents a loss of their expertise and knowledge (Helterbran, 2016). Teachers' involvement enhances motivation and commitment, while also supporting organizational learning and change through interaction and collaboration (Leithwood et al., 2009). As professional learning is embedded in social interaction rather than individual isolation (De Felice et al., 2022), DL emphasizes that meaningful educational development occurs through "action in interaction" (De Felice et al., 2022, p. 10). In this context, teachers not only improve their own practice, but also shape the practices of others, contributing to a dynamic and evolving school culture. Innovative practices, including pedagogical strategies, technological integration, and personalized learning create dynamic, student-centered learning environments (Leithwood et al., 2009; Phillips et al., 2023).

In parallel, invitational leadership (IL) offers a relational perspective on school improvement. Defined as "a viable process for improving schools" (Asbill & Gonzalez, 2022, p.14), IL focuses on creating collaborative environments grounded in trust, respect, care, optimism, and intentionality (Purkey & Stanley, 1991; Purkey, 1992; Burns & Martin, 2010; Shaw and al., 2013; Purkey & Novak, 2015). Originating in the work of William Purkey in the early 1970s (Burns & Martin, 2010; Shaw and al., 2013; Asbill & Gonzalez, 2022), IL emphasizes the importance of relational ecosystems in which individuals feel valued, responsible, and capable of growth (Purkey, 1992; Egley, 2003). Through intentional interactions, principals shape school climates that include students, teachers, and parents within a shared organizational space (Burns & Martin, 2010; Shaw and al., 2013; Legros & Ryan, 2015; Purkey & Novak, 2015), often conceptualized through the "five P's": people, places, policies, programs, and processes (Burns & Martin, 2010; Shaw and al., 2013; Legros & Ryan, 2015; Purkey & Novak, 2015).

Empirical findings suggest that invitational leadership is related to positive teacher outcomes, including trust, respect, and job satisfaction (Legros & Ryan, 2015; Asbill & Gonzalez, 2022; Younis, 2022). Inviting comes from the Latin term *invitare* (Purkey &

Stanley, 1991; Purkey & Novak, 2015), meaning “to offer something beneficial for consideration” (Purkey & Novak, 2015, p.1) and it represents the continuous interactions taking place in educational settings (Purkey & Novak, 2015). IL transforms the school environment into a more supportive and inclusive space where collaboration replaces isolation (Legros & Ryan, 2015), enabling individuals to realize their potential (Purkey & Stanley, 1991; Purkey, 1992). In this way, IL contributes to the creation of relational conditions that sustain engagement and professional growth.

Taken together, TL, DL, and IL approaches highlight that school improvement emerges from shared responsibility, vision, relational trust, and collective engagement. However, while these leadership frameworks explain how supportive organizational conditions are created, they do not fully clarify how adaptive capacity emerges in everyday classroom practice. In other words, leadership can establish vision, structure, and relational climate, but it is at the micro level that these conditions are translated into concrete educational actions. Micro-foundations show how individual-levels factors impact organizations, how the interaction of these individuals leads to outcomes (Palmié et al., 2023).

Organizational resilience depends not only on the leadership style, but also on how teachers act and react within complex classroom situations. The role played by social interactions is important in human learning (De Felice et al., 2022) and motivation stands for the mobilization of emotions to reach goals (Goleman, 2016). Therefore, the aim of this article is to shift the focus from leadership structures to micro-level mechanisms, including teacher autonomy and flow, as processes through which pedagogical classroom practices emerge and contribute to organizational resilience in educational settings.

Teacher Autonomy and Flow

Teachers play a central role in shaping both learning processes and school development, particularly when they assume leadership roles within and beyond the classroom (Danielson, 2007; Labelle & Jacquin, 2018; Soares, 2020). As holders of institutional memory and custodians of school culture (Danielson, 2007), they bring essential expertise in teaching and learning practices, directly influencing student outcomes (Kamaruzaman et al., 2020). Effective principals recognize that teacher contribution is fundamental to student success (Allen et al., 2015), creating safe and supportive learning environments that enable teachers to perform at their best (Robinson, 2006). What teachers accomplish professionally is connected to who they are as individuals (Purkey & Stanley, 1991), highlighting the importance of personal, emotional, and social dimensions in educational practice.

When schools have a positive climate, teachers are better motivated (Legros & Ryan, 2015) and they also create motivating learning environments for their students (Immordino-Yang & Damasio, 2007). “Perhaps more important, in the real world, motivation is highly valued because of its consequences: Motivation produces.” (Ryan & Deci, 2000, p. 69). Learning is the force that shapes leaders and every learning expertise is unique (Burns, 2012). Humans are emotional and social creatures and students’ performance and learning are affected by emotions and feelings (Immordino-Yang & Damasio, 2007). This sense of belonging (Immordino-Yang & Damasio, 2007) is often reflected in transformational cultures characterized by shared purpose and a “feeling of family” (Bass & Avolio, 1993, p.116).

Within this context, teacher autonomy emerges as a key condition for effective professional functioning. TL contributes to teacher self-efficacy (Li & Liu, 2020) by empowering teachers so that they can become less dependent on their leader (Yukl, 1999).

Teacher leaders lead within and outside of the classroom (Fitzgerald & Gunter, 2008). “From the moment a teacher walks into a classroom, he or she is a leader” (Soares, 2020, p. 97). Teachers’ expertise in teaching and learning allows them to become more committed to the school environment when principals view them as partners in the school program (Allen et al., 2015).

Grounded in emotional, social, and moral background (Immordino-Yang & Damasio, 2007), teaching relies on motivation understood as the mobilization of emotions toward meaningful goals (Goleman, 2016). According to Ryan and Deci (2000), when the basic psychological needs of autonomy, competence, and relatedness are fulfilled, individuals experience higher levels of motivation, engagement, and commitment. Autonomy supports innovation and the expression of ideas (Former et al., 2021), enabling teachers to adapt their pedagogical strategies to diverse classroom contexts. Such adaptive practices not only improve immediate learning outcomes, but also generate positive feedback loops that strengthen both individual and organizational capacity to respond to future challenges (Vogus & Sutcliffe, 2007). In this sense, resilience in the classroom also comes from adjusting pedagogical strategies in order to find the ones which promote learning.

The concept of flow was created in the 70s (Aubé et al., 2014; Shernoff et al., 2014; Oliveira et al., 2018; Engeser et al., 2021) and according to Mihalyi Csíkszentmihályi, flow is a state of deep concentration, an activity perceived as intrinsically enjoyable (Bakker, 2005; Aubé et al., 2014; Heutte et al., 2021), though not always necessarily pleasant (Csíkszentmihályi, 1990). Flow means to be fully involved in the present moment, which contributes to well-being and personal satisfaction (Csíkszentmihályi, 1990; Schüler, 2007; Aubé et al., 2014), fostering personal growth (Bakker, 2005; Engeser et al., 2021; Heutte et al., 2021) and a sense of mastery (Csíkszentmihályi, 1990; Mazid et al., 2024).

This state is defined by three main elements, absorption, enjoyment, and intrinsic motivation (Bakker, 2005). When in flow, teachers feel connected to their classroom (Shernoff et al., 2014) and achieve an internal state of harmony (Csíkszentmihályi, 1990). The key to understanding flow is the autotelic experience, the result of an activity that produces its own intrinsic motivation (Oliveira et al., 2018). Knowledge always flows from a higher level to a lower one (Brătianu & Bejinaru, 2019), whereas teachers learn from their students’ reactions. This connection is explained through our human nature, as we are biologically programmed to find relatedness (Csíkszentmihályi, 1990).

Flow is not only an individual experience, but also a relational and social phenomenon. It is closely linked to interaction and connection, as human beings are naturally oriented toward relatedness (Csíkszentmihályi, 1990). In educational settings, flow can spread from one individual to another through emotional contagion (Bakker, 2005), meaning that teachers’ and students’ experiences influence each other. Teachers often derive their own flow from students’ engagement (Shernoff et al., 2014), and when in flow, they feel connected to their classroom and experience a sense of internal harmony (Csíkszentmihályi, 1990; Shernoff et al., 2014). “Flow is a motivating force for excellence.” (Shernoff et al., 2014, p. 212). When learning becomes enjoyable and meaningful, students are more likely to seek it (Schweinle et al., 2006), and flow becomes a source of energy that can be directed toward learning (Csíkszentmihályi, 2014).

Flow is experienced when the challenges and skills match (Bakker, 2005; Schüler, 2007; Csíkszentmihályi, 2014; Shernoff et al., 2014; Engeser et al., 2021). Also called optimal

experience or autotelic activity (Shernoff et al., 2014), flow depends on this balance, requiring autonomy and competence. In the classroom, teachers play an essential role in creating these conditions by adapting tasks to students' needs and allowing them to choose or adjust their level of challenge (Schweinle et al., 2006; Csíkszentmihályi, 2014). Teachers should make the present moment count, not the future, allowing students to choose their own level of challenge, then connect them with the right level of opportunity for learning (Csíkszentmihályi, 2014). By designing meaningful instructional experiences, teachers support the development of competence and autonomy (Schweinle et al., 2006), while also reducing distractions and overstimulation in order to help students maintain focus and enter a state of flow (Csíkszentmihályi, 1990).

Flow is related to learning, as it enhances focus, perseverance, motivation, and determination (Schüler, 2007; Shernoff et al., 2014; Mazid et al., 2024). However, schools often struggle to provide engaging and meaningful learning experiences (Shernoff et al., 2014), which makes the role of teachers even more important. "An obvious influence on students' engagement and flow experience is the teacher." (Shernoff et al., 2014, p. 219). Teachers who use varied instructional strategies are more likely to experience and facilitate flow (Smith, 2009 as cited in Shernoff et al., 2014), creating environments that support active and engaged learning. Each flow experience contributes to a sense of discovery and creativity, transforming the individual and supporting personal development (Csíkszentmihályi, 1990). Since learning is not only cognitive, but also affectively charged (Schweinle et al., 2006), it is important to create conditions that support sustained engagement and dedication. In this context, autonomy and social support act as important resources that help maintain the balance between skills and challenges, thus positively contributing to the experience of flow (Bakker, 2005).

Teacher autonomy and flow together explain how resilience is developed in everyday educational practice. Autonomy allows teachers to make decisions, adjust their strategies, and respond to the diverse needs of their students (Former et al., 2021). At the same time, flow supports deep engagement, focus, and sustained effort, enabling teachers to function in complex and dynamic classroom environments (Schüler, 2007; Aubé et al., 2014; Mazid et al., 2024). When these two processes interact, teachers are more likely to design meaningful learning experiences, regulate the level of challenge, and maintain students' engagement (Schweinle et al., 2006; Csíkszentmihályi, 2014). They add energy efficiently, not equally, in order to regulate the knowledge fields, represented as rational, emotional, and spiritual (Brătianu & Bejinaru, 2019). By creating motivating supportive learning environments, teachers provide opportunities for students to achieve competence and autonomy, while developing organizational resilience.

Micro-Foundations and Organizational Resilience

The concept of micro-foundations, introduced by Lippman and Rumelt (Palmié et al., 2023), explains how individual-level factors influence organizational outcomes through interaction and practice (Felin & Foss, 2015; Palmié et al., 2023). Although there is a lack of consensus regarding its use, the concept highlights the importance of understanding how agency, levels, and mechanisms operate together (Haack et al., 2019). Organizational resilience is not just the product of structures, but also the combination of cognitive, communicative, and behavioral processes through which individuals interpret, interact, and act. This approach is reflected in Coleman's boat, which illustrates how social facts are translated into social outcomes through individual actions and interactions (Felin & Foss, 2015; Palmié et al., 2023).

At the classroom level, learning and performance are influenced by teachers' actions and interactions. Teachers design scaffolding strategies within supportive environments to help students achieve their learning goals (Valerio, 2012). Students who think they are able to solve problems will be more motivated than those who don't (Pintrich, 2003). Motivation arises when students receive clear instructions from the teachers, but also when they feel they are accepted and seen (Price, 2012). Teachers should provide constructive feedback, create stimulating workload, and build a predictable, safe learning environment, in order to improve student outcomes (Pintrich, 2003). "When people feel better, they perform better." (Goleman & Boyatzis, 2008).

Since there is no single right strategy to tailor classroom design (Pintrich, 2003), teachers need to address the unique needs of every community. Resilience isn't just adaptation. It creates resources that can be activated or combined in new situations (Vogus & Sutcliffe, 2007). In the classroom, resilience results from the processes and dynamics that become visible at the micro level of everyday practice. The context may improve or hinder learning and motivation, this is why the teacher's strategies matter (Pintrich, 2003). In this sense, the classroom teacher becomes the central factor in shaping the culture of the classroom (Purkey & Stanley, 1991), while leadership is enacted through everyday interactions between people and situations (Helterbran, 2016).

Organizational resilience is commonly defined as the ability to maintain positive adjustment under challenging conditions (Sutcliffe & Vogus, 2003; Vogus & Sutcliffe, 2007), to cope with stress, and to adapt to change (Warner & April, 2013; Dong, 2023). It is considered a multidimensional organizational capability (Duchek, 2020; Evenseth et al., 2022), involving the use of internal and external resources to resolve issues (Sutcliffe & Vogus, 2003), a developed trait needed to cope with daily stress and to adapt to change (Warner & April, 2013; Dong, 2023).

Resilience is also connected to engagement (Colignon et al., 2024), motivation (Sutcliffe & Vogus, 2003), and the ability to remain focused and productive in difficult situations (Warner & April, 2013). Moreover, it is linked to organizational learning, as learning both contributes to and results from resilience processes (Vogus & Sutcliffe, 2007; Evenseth et al., 2022). In this sense, resilience is not only about recovering from adversity, but also about developing new resources and capacities that can be activated in future situations (Vogus & Sutcliffe, 2007). While leadership plays an important role in shaping school climate and supporting resilience (Hallinger, 2003; Price, 2012; Anderson, 2017; Colignon et al., 2024), it does not fully explain how resilience is enacted in practice.

Leadership influences organizational conditions, including trust, collaboration, and access to social capital (Coleman, 1990), which are associated with job satisfaction, cohesion, and commitment (Tschannen-Moran, 2001; Price, 2012). Invitational leadership, for example, creates opportunities for individuals to develop authentically within relational environments (Purkey & Novak, 2015), while effective principals foster supportive and people-oriented cultures (Burns & Martin, 2010). However, resilience emerges through the interaction of individuals within these contexts, not from leadership structures alone. Students and teachers often experience school differently (Fitzgerald & Gunter, 2008), and formal rules may not always reflect their actual needs (Purkey & Stanley, 1991), which underlines the importance of creating supportive learning environments where teachers can promote students' performance (Valerio, 2012).

From a micro-foundational perspective, resilience is built through everyday practices that take place in the classroom. Teachers continuously interpret situations, make decisions, and adjust their strategies in response to students' needs. These adaptive practices promote competence and growth (Vogus & Sutcliffe, 2007), contribute to student motivation and performance, and generate learning processes that strengthen the organization over time (Evenseth et al., 2022). Therefore, organizational resilience in schools can be understood as the result of interconnected micro-level processes, where teachers' autonomy, engagement, and adaptive practices transform available resources into sustained capacity for coping, leadership learning, and development. These micro-foundations could be interpreted as effective strategies and managerial abilities that play pivotal roles in shaping the quality of education (Groenewald et al., 2024).

3. Methodology

This study uses a conceptual research design based on an integrative review of literature in educational leadership, motivation, and organizational resilience. The paper synthesizes key theoretical perspectives, including transformational, distributed, and invitational leadership, self-determination theory, and flow theory, in order to explore the relationships between leadership, teacher autonomy, and adaptive practices. The research discussed was identified by using keywords such as transformational leadership, distributed leadership, invitational leadership, teacher autonomy and flow, organizational resilience. The outcome of this research is a conceptual model that explains educational resilience through everyday teacher practices, considered micro-foundations within the classroom.

4. Results and Discussion

This study proposes a conceptual model that explains organizational resilience in educational settings as an emergent process of three leadership styles, TL, DL, and IL, and micro-level processes. It suggests that these leadership styles play a significant role in shaping the organizational context, while creating the relational and structural conditions which enable teachers to design motivating learning environments. School leaders acknowledge that teachers are the most important components for student success (Allen et al., 2015). TL contributes by providing vision, motivation, and shared goals, thus inspiring change (Heenan et al., 2024), while DL supports participation, collaboration, and shared responsibility, allowing teachers to improve students outcomes (Harris, 2003). IL fosters trust, respect, and care, designing environments in which every individual feels valued and supported (Purkey, 1992).

However, the findings of this study highlight that organizational resilience is not located at the level of leadership alone. Rather, it emerges through micro-level processes that take place in the classroom, as individual level factors impact organizations and their interactions lead to outcomes and performance (Felin & Foss, 2015). Within this process, teacher autonomy and flow are identified as key mechanisms, since teachers are catalysts for change (Harris, 2005), while building the school's capacity for improvement (Chan, 2019). Schools have always struggled to offer meaningful and engaging learning experiences (Shernoff et al., 2014), and flow could be the answer, as teachers who adapt to the needs of the students, applying different strategies are more likely to experience higher levels of flow (Smith, 2009).

as cited in Shernoff et al., 2014). In this sense, the classroom becomes the primary space where organizational resilience is built.

5. Conclusions

The main contribution of this study is the shift from viewing resilience as a structural capability to understanding it as an emergent outcome of practice. By focusing on teacher autonomy and flow, the paper highlights the role played by motivation, engagement, and support in building sustainable organizational resilience. In this perspective, teachers are not only catalysts for change (Harris, 2005), but also active agents who can contribute to the school's ability to cope with uncertainty and to evolve.

As a conceptual study, this paper has certain limitations. The proposed model requires empirical validation in different educational contexts, in order to examine the relationships between leadership, autonomy, and flow. Future research could explore these aspects using various approaches, in order to validate both the role of leadership strategies and the everyday teaching practices. These micro-level educational processes could be the simplest expression of resilience in education: "What you want to do is to give the child the freedom and the motivation to go on learning for the rest of life." (Csíkszentmihályi, 2014), thus cultivating the desire to continue learning, regardless of how the future unfolds.

6. References

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ALIGNING CIRCULAR FASHION BUSINESS MODELS WITH THE EU TEXTILES STRATEGY

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Abstract: *This article examines how circular fashion business models can be aligned with the European Union policy framework for sustainable and circular textiles. It analyses resale, rental, repair-as-a-service, and product-as-a-service as distinct but complementary mechanisms for extending garment life, intensifying asset utilisation, and recovering post-consumer value. Methodologically, the study adopts a qualitative conceptual approach based on a thematic synthesis of academic literature, institutional reports, and EU regulatory documents. The discussion focuses on four interrelated dimensions: design for longevity and disassembly; the economic tension between growth and circularity, particularly the risk of sales cannibalisation; data governance and digital traceability through the Digital Product Passport; and reverse logistics as a precondition for value recovery. The analysis suggests that circularity is viable not as a single universal model, but as a category-specific portfolio of strategies whose performance depends on durability, residual value, operational costs, and the quality of product information. The findings further indicate that the most plausible transition pathway for fashion firms is a hybrid management model that combines conventional sales with repair, resale, rental, and take-back channels. Within the evolving EU regulatory environment, competitive advantage will depend less on symbolic sustainability claims than on the organisational capacity to integrate compliance, traceability, and lifecycle monetisation into a coherent business architecture.*

Keywords: Circular fashion, EU textiles strategy, unit economics, product-as-a-service, reverse logistics, Digital Product Passport.

Classification JEL: O44, Q52, Q56.

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1. Introduction

The transition of the fashion industry from a linear model of production and disposal to a more circular logic is being shaped by both environmental pressure and regulatory intervention. In the European context, this shift has acquired particular strategic importance. The Circular Economy Action Plan established product sustainability, waste prevention, and resource retention as central policy priorities (European Commission, 2015), while the EU Strategy for Sustainable and Circular Textiles extended these principles to the textile and apparel sector specifically (European Commission, 2022). More recently, the Ecodesign for Sustainable Products Regulation and the Digital Product Passport have reinforced the regulatory emphasis on durability, reparability, traceability, and producer responsibility (European Union, 2024). In parallel, revisions to EU waste policy affecting textiles and ongoing consultations on the implementation of the Digital Product Passport indicate that circularity is increasingly being translated into operational requirements rather than remaining a purely declarative objective (European Commission, 2025a, 2025b).

Against this background, circularity should not be treated solely as a normative aspiration. It is also a managerial and economic challenge. Fashion brands are required to reconsider how value is generated once garments are understood not as short-lived commodities, but as assets whose utility can be extended, recaptured, and redistributed. This raises several interconnected questions. Which circular business models are most appropriate for different apparel categories? How can firms avoid or manage the risk that circular offerings merely displace new-product sales? What technological and logistical infrastructures are required for circularity to function at scale? This article addresses these questions through a conceptual analysis of the strategic alignment between circular business models and the evolving EU textiles policy framework.

2. Literature Review

Strategic Transitions towards Circular Fashion

The contemporary fashion industry remains predominantly structured around a linear 'take-make-dispose' model, which is resource-intensive and environmentally damaging (Niinimäki et al., 2020). In response, the circular economy has been advanced as a restorative framework aimed at reducing material throughput, minimising waste, and retaining value for longer periods (Ellen MacArthur Foundation, 2017; Meshram, 2024; Niinimäki et al., 2020). Recent studies on sustainable garment design emphasize the practical application of sustainability principles in the development of clothing collections (Graur et al., 2025). The literature commonly distinguishes between narrowing resource use, closing material loops, and slowing product flows through longer periods of use (Niinimäki et al., 2020; Rahee & Sarker, 2024; Scripcenco & Pashkevich, 2020). Among these approaches, strategies that prolong the active life of garments are often presented as especially important because they preserve more of the embedded value of materials, labour, and design (Ellen MacArthur Foundation, 2024; Niinimäki et al., 2020; WRAP, n.d.). Redesign, reuse, and 3D prototyping may contribute to more efficient sustainable fashion practices by extending product value and reducing material waste (Scripcenco & Graur, 2024).

A substantial body of scholarship argues that circularity must begin at the design stage. Design for longevity, design for repair, and design for disassembly are repeatedly identified as core principles of circular fashion systems (Niinimäki et al., 2020; Rahee & Sarker, 2024). These strategies concern not only technical durability, but also what has been described as 'emotional durability', namely the capacity of a garment to remain culturally, aesthetically, and functionally meaningful over time (Ellen MacArthur Foundation, 2024; Niinimäki et al., 2020). Innovative solutions for disassembly, including technologies such as Smart Stitch™, further demonstrate that recyclability is closely linked to early design decisions (Rahee & Sarker, 2024; Resortecs, n.d.).

The literature also highlights the growing importance of business-model innovation. Product-service systems, including leasing, rental, take-back, repair, and resale, shift attention from one-off transactions to repeated value recovery across the product lifecycle (Ellen MacArthur Foundation, 2024; Niinimäki et al., 2020; Rahee & Sarker, 2024). Examples such as Patagonia's Worn Wear and other branded repair or resale platforms illustrate how firms can combine environmental positioning with customer retention (Patagonia, n.d.). At the same time, recent studies in the regional academic context have framed circular fashion not only as an industrial transformation, but also as a pedagogical

and cultural one, linking business-model transition to competence development, design innovation, and changing consumption practices (Scripcenco, 2025; Scripcenco & Borş, 2024; Scripcenco & Pashkevich, 2020).

Despite these advances, several gaps remain. First, there is still limited evidence regarding the extent to which circular offers complement or cannibalise primary-market sales (Ellen MacArthur Foundation, 2024; Niinimäki et al., 2020). Secondly, economically viable reverse logistics systems remain difficult to organise because they require dense collection networks, sorting capacity, and reliable information flows (Ellen MacArthur Foundation, 2017, 2024; Niinimäki et al., 2020). Thirdly, information asymmetry persists across supply chains, especially with regard to fibre composition, chemical content, and product history, which constrains reuse, repair, and recycling (European Union, 2024; Niinimäki et al., 2020; Rahee & Sarker, 2024). These gaps justify a closer conceptual examination of how policy, design, logistics, and business strategy intersect in the circular transition of fashion.

3. Methodology

This study employs a qualitative conceptual research design. Rather than testing a single empirical hypothesis, it synthesises academic literature, institutional reports, and regulatory documents in order to identify the principal strategic conditions under which circular business models may become viable in the fashion sector (Ellen MacArthur Foundation, 2024; Niinimäki et al., 2020; Rahee & Sarker, 2024). The article is therefore positioned as a narrative review with an analytical purpose: to clarify how economic, logistical, and regulatory considerations converge in the transition from linear to circular fashion systems.

The source base was organised into three categories. The first comprised peer-reviewed academic publications on sustainability, textile technology, circular product design, and environmental economics (Meshram, 2024; Niinimäki et al., 2020; Rahee & Sarker, 2024). The second included institutional and industry reports, especially those published by the Ellen MacArthur Foundation and WRAP, which provide influential conceptual frameworks and widely cited evidence on product lifetimes, value retention, and systemic redesign (Ellen MacArthur Foundation, 2017, 2024; WRAP, n.d.). The third category consisted of EU policy and regulatory documents related to circular economy governance in the textile sector (European Commission, 2015, 2022, 2025a, 2025b; European Union, 2024).

The material was analysed through thematic synthesis. Four analytical dimensions were used to structure the discussion: theoretical foundations of circularity; design and business-model strategies; technological and informational enablers, particularly digital traceability; and economic or organisational barriers, including reverse logistics and the risk of sales displacement. This framework makes it possible to assess circularity not as an abstract ideal, but as a set of operationally differentiated and economically conditioned pathways.

4. Results and Discussion

Circular business models in fashion differ according to how they extend product life, intensify product use, or transform ownership relations. Resale preserves value by moving garments into secondary markets after initial use. Rental increases the number of users per product and is most appropriate where garments have high symbolic or occasion-specific value but low repeat use by a single owner. Repair-as-a-service prolongs useful life by

keeping garments functional and desirable for longer periods. Product-as-a-service goes further by retaining ownership with the firm and monetising access, performance, or duration of use rather than the transfer of ownership (Ellen MacArthur Foundation, 2024; Niinimäki et al., 2020; Rahee & Sarker, 2024).

These models are not interchangeable. Their feasibility depends on garment category, material durability, hygiene requirements, care costs, aesthetic obsolescence, and consumer expectations. High-value staples, children's clothing, and premium outerwear are particularly suitable for resale because they retain both functional and symbolic value after first use. Rental is more compatible with occasion wear, maternity clothing, or high-fashion items whose individual wear frequency is structurally low. Repair is especially relevant for products whose longevity can be restored through relatively standard interventions, such as denim, leather goods, and outerwear. Product-as-a-service is most plausible where reliability, standardisation, and lifecycle control matter more than personal ownership, as in uniforms or performance gear.

The analytical significance of this classification lies in demonstrating that circularity is not a single business model, but a family of models. The strategic question is therefore not whether a brand should become circular in the abstract, but which form of circularity corresponds to the economics and materiality of its products.

Table 1. Circular Fashion Business Models

Model	Best-fit categories	Strategic strength
Resale	High-value staples, luxury, children's wear	High consumer trust; comparatively low carbon impact per transaction.
Rental	Occasion wear, maternity wear, high-end trends	Maximises users per product for items with low individual wear frequency.
Repair	Denim, outerwear, leather goods	Strengthens brand loyalty; supports durability and after-sales compliance.
Product-as-a-service (PaaS)	Performance gear, corporate uniforms	Suitable for high-utility items where reliability matters more than ownership.

Source: Authors' elaboration based on Ellen MacArthur Foundation (2017, 2024), Niinimäki et al. (2020), and Rahee and Sarker (2024).

One of the principal objections to circular fashion is the risk of cannibalisation. If a consumer rents, repairs, or purchases used garments, the firm may sell fewer new units. In a conventional linear model this appears threatening because revenue is tied to throughput. However, the cannibalisation argument becomes less decisive once the firm shifts from a volume-based logic to an asset-based logic. From this perspective, the relevant question is not how many new products are sold, but how much cumulative value can be extracted from a garment over time (Ellen MacArthur Foundation, 2017, 2024).

This shift has several implications. First, product durability acquires a different economic meaning. In a linear model, rapid turnover may sustain sales; in a circular model, low durability becomes a cost multiplier because it undermines resale value, repair viability, and service continuity. Secondly, recurring service interactions can deepen customer relationships. Repair, take-back, and resale platforms create repeated points of contact that may enhance customer lifetime value even when primary sales decline. Thirdly, profitability depends on disciplined unit economics. Circular models are viable only when residual product value exceeds the operational costs of cleaning, sorting, authentication, repair, redistribution, and digital administration.

For this reason, circular fashion should not be idealised. It does not automatically produce superior returns. Its economic promise is conditional and category-specific. Nevertheless, the shift from sales volume to asset utility offers an important conceptual bridge between sustainability objectives and business performance.

If circularity depends on keeping products in use longer and routing them intelligently through reuse, repair, or recycling pathways, then information becomes a strategic resource. Circular systems require not only physical products but also reliable product identities. Composition, provenance, care history, repair records, and end-of-life options all influence whether a garment can be authenticated, resold, repaired, or disassembled efficiently. In this context, the Digital Product Passport should be understood as an enabling infrastructure rather than a simple compliance label (European Commission, 2025b; European Union, 2024).

Its value lies in linking sustainability information to operational decision-making. For resale, traceability can support authenticity and pricing. For repair, it can provide material specifications and intervention guidance. For recycling, it can improve sorting decisions and reduce uncertainty regarding fibre composition. The Digital Product Passport is therefore relevant across the entire lifecycle of textile assets. However, the usefulness of digital traceability depends on data quality and interoperability. A passport populated with incomplete, inconsistent, or commercially inaccessible information will not support circularity in practice. The core challenge is therefore one of governance: who records the data, who verifies it, who can access it, and how these data move across brands, platforms, logistics providers, and recycling systems (European Commission, 2025b; European Union, 2024; Rahee & Sarker, 2024).

Reverse logistics constitutes another strategic condition of circularity. In linear production systems, the return of products from consumers to firms is usually treated as an exception or a cost. Circular systems reverse this assumption. Reverse logistics becomes a core capability because it determines whether post-consumer garments can be captured, assessed, and redirected towards their highest-value next use. In this sense, take-back schemes are not simply instruments of waste collection; they are mechanisms for asset recovery and material intelligence (Ellen MacArthur Foundation, 2017, 2024).

The economic significance of reverse logistics depends on sorting quality. Returned garments must be differentiated according to condition, authenticity, repairability, resale potential, and material recoverability. Each route has different value implications. A garment suitable for direct resale preserves more embedded value than one that must be processed into fibre feedstock. A garment that can be repaired and returned to circulation may generate both service income and future resale value. Reverse logistics should therefore be understood not as downstream waste management, but as part of the upstream resource strategy of the firm.

At the same time, reverse logistics is one of the most difficult dimensions of circularity to scale. Collection density, labour intensity, transport costs, cleaning requirements, and uneven product quality can rapidly erode margins. Consequently, the strategic success of take-back schemes depends not merely on their existence, but on how effectively they connect physical returns with digital information and economically differentiated treatment routes.

A realistic transition pathway for fashion brands is unlikely to involve abandoning new-product sales altogether. A more plausible scenario is the development of a hybrid management model that combines conventional sales with circular service and recovery channels. Such a model recognises that firms must operate simultaneously within two

temporalities: the current market logic of new-product transactions and the emerging logic of circular asset management.

This hybrid model can be conceptualised in three stages. The first is stabilisation, in which the brand improves durability, introduces repair capacity, and begins incorporating compliance costs into business planning. The second is diversification, in which the firm develops controlled channels for resale, rental, or take-back in order to retain value that would otherwise migrate to third-party platforms or disappear into waste streams. The third is optimisation, in which product data, reverse logistics, and service history are integrated into a coherent management system capable of anticipating maintenance needs, routing products efficiently, and informing improved design decisions in future collections.

The advantage of the hybrid approach is that it does not present sustainability and profitability as absolute opposites. Instead, it treats compliance, service provision, and lifecycle management as components of a new business architecture. The challenge, however, lies in organisational coherence. Circular activities must be embedded in product design, sourcing, after-sales service, and information systems. If they remain isolated pilot projects, they are likely to stay peripheral and financially fragile.

Despite the strategic appeal of circular fashion, several barriers remain. The first is technological. Textile recycling is still constrained by fibre blends, additives, and quality loss, which limit the transformation of garments into high-quality secondary raw materials (Niinimäki et al., 2020; Rahee & Sarker, 2024). The second is informational. Interoperable data standards across suppliers, brands, service providers, and recyclers remain underdeveloped (European Commission, 2025b; European Union, 2024). The third is behavioural. Consumers may express support for sustainable fashion while continuing to prioritise low prices, novelty, and ownership. This gap between declared values and actual purchasing behaviour complicates the scaling of rental and service-based models.

A fourth barrier concerns cost distribution. Reverse logistics, repair systems, and digital traceability infrastructures require substantial upfront investment, yet the financial returns may emerge only gradually. Large brands may absorb these transition costs more easily than smaller firms. This raises an important policy question: whether regulation alone is sufficient, or whether circular transition also requires coordinated incentives, common technical standards, and support for innovation in material recovery, digital infrastructure, and business-model experimentation.

5. Conclusions

The transition towards circular fashion represents a structural redefinition of how value is created, retained, and measured in the textile industry. It cannot be reduced to recycling rhetoric or isolated sustainability initiatives. Rather, it requires the alignment of business models, material design, information systems, and logistics infrastructures with a policy framework that increasingly rewards durability, transparency, and responsibility for post-consumer outcomes.

The analysis developed in this article suggests that circularity becomes most persuasive when garments are managed as long-lived assets rather than one-time sales units. In such a framework, resale, rental, repair, and product-as-a-service are not peripheral additions, but alternative mechanisms for value extension and recovery. Their success, however, remains

contingent upon product category, data integrity, operational discipline, and the economic design of return and service systems.

For fashion brands operating within the European regulatory environment, the central lesson is clear: the competitive advantage of circularity will not arise from symbolic green positioning alone. It will depend on the organisational ability to integrate compliance, traceability, and lifecycle monetisation into a coherent, credible, and scalable business model.

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STRESS MANAGEMENT STRATEGIES AND COGNITIVE SCHEMAS SPECIFIC TO POLICE OFFICERS FROM THE OPERATIONAL STRUCTURES OF THE ROMANIAN POLICE

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Abstract: *This study aims to identify the cognitive schemas and the coping mechanisms in newly employed staff within the Ministry of Internal Affairs, at the level of a police subunit, in order to come up with a training program which increases their resilience to institutional demands. The group that took part in this survey consisted of 275 individuals, both agents and police officers, graduates of post-high school studies/relevant university studies or persons employed from external sources. Two research tools were applied, and they aided in the identification of the connection between the cognitive schemas and the coping strategies in order to design a new institutional intervention program whose goal is to mitigate the early non-adaptive cognitive schemas and the development of adaptive coping mechanisms.*

Keywords: *stress, police officers, coping strategies, cognitive patterns, institutional intervention program.*

Classification JEL: D23, M54.

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1. Introduction

The police officer represents a public servant with a special status that carries out his/her activity within the Police Force and who, while fulfilling his/her work tasks or duties, usually wears a uniform and possesses a firearm. A number of roles are attributed to the police officer's status, together with many rights, obligations, responsibilities and interdictions. The particularities of their status are represented by the duties and obligations they have in their interactions with the citizens and with other public institutions. What is more, they have to carry a firearm during various missions and may be exposed to special risks. The status of being part of the police force is attained once the oath of faith is sworn and the first rank is granted (police agent/police officer).

The law enforcers, irrespective of the firearm they carry, constantly undertake a state of hypervigilance and stress while carrying out their professional duties. The stages in which the demands attributed to the staff working within the Ministry of Internal Affairs may surpass their ability to respond adequately (both physically and mentally) and may vary in length and frequency. The constant action of stress factors on employees that carry out their duties or missions which require intense mental demands can manifest, when no effective coping strategy is employed, as: "exhaustion, slower mental processing, confusion, hesitation, increased sensitivity, anger, uncertainty, overreaction, heightened response to fear" (Dumitran, D., 2021). A prolonged exposure to a state of mental and physical stress may inevitably lead to behavioral, emotional, mental and physical alterations. In the absence

of an effective stress management strategy and of some adaptive cognitive schemas, the possibility of obtaining or maintaining professional efficiency is significantly diminished.

In order to ensure the adaptation to institutional requirements and to maximize the existing potential, the identification of the right coping strategies and emotional and cognitive schemas is essential. The conformation to the status of police officer brings about a series of significant modifications both in their professional and social aspects of life. Social interactions also change. During work hours, police officers usually intervene in situations where they register a lot of negative emotions in order to prevent the escalation of conflicts or to solve problems within the confines of the law. They are thus exposed, in most situations, to intense feelings of fear, pain or impending death. Exposure to critical incidents may be reflected both within the physical and mental planes. Not knowing the specificities of the cases which they will be confronted with in the hours that follow makes the police officers' activity one in which the emotional load may fluctuate greatly when bearing in mind their complexity and intensity.

In order to manage the critical situations as effectively as possible, the organization can anticipate the needs of its newer employees by including them in a program which aims to mentally train them so that they are able to manage sudden, unexpected events where uncertain, unclear elements outnumber the circumstances which are familiar, namely those situations which don't allow the classic stages of the decision-making process to unfold. By knowing the cognitive schemas and the strategies of coping with stressful situations on behalf of the newly appointed staff from the very beginning may we help the organization establish an institutional endeavor which, in turn, increases the resilience of police officers.

The acknowledgement of the effects when analyzing the interactions between cognitive schemas that carry a dysfunctional potential and the ineffective coping mechanisms of the newly employed staff and their identification in the behavior of subordinates and employees represent an important aspect of the labor managers who can use this vital information when implementing efficient intervention strategies.

2. Literature Review

The professional studies regarding cognitive schemas are rather limited when we take into consideration the police environment and even less so when we correlate it to stress management and the impact study on professional activity. The necessity of this endeavor lies precisely inside this informational deficit and the impact which it may have on the organization and the people that carry out their activities within this institution. The concept of cognitive schemas is defined as: "a range of topics regarding the self and the relationships with other people which usually develops during childhood, which are elaborated throughout adulthood and may be dysfunctional to some extent" (Young, J., 2003, quoted by David, D., 2020).

The same author, within the pages of the same essay, underlines the fact that these cognitive schemas are "responsible for generating a strong emotional distress" which leads to non-conformity both for the self and for those around. They are stable behavioral patterns resulting from the interaction between the innate aspects of personality and those aspects which pertain to the environment where an individual develops; these aspects are activated in various life contexts, thus influencing the way in which the subjects perceive and interpret

reality; they are convictions which can limit the capacity for adaptation and emotional self-tuning that each individual bears within, hence contributing to a less harmonious development of these subjects.

The cognitive schemas mentioned earlier, although deeply ingrained due to daily experiences and social interactions, “continue to develop and transform throughout life” (Lemme, B.H., 2006). And yet, the human brain bears that feature which, by means of these cognitive schemas, enables it to select the information that it comes into contact with by focusing on the data being coordinated with the content of such schemas and by ignoring the information that contradict it; “the cognitive schemas affect the thinking process and are used to organize knowledge, to guide behavior, to predict probable events and to understand the current experiences and organize knowledge. These mental frameworks also determine the exclusion of pertinent information in order to focus only on those elements which confirm preexisting beliefs and ideas” (Popescu, M.A., 2021). What’s more, “the pattern which is activated under the influence of circumstance determines the processing particularities of information coming from the exterior and its assessment, given the pre-existing non-adaptive beliefs which are coupled with the symbolizing process of subjective experience” (Pleşca, M., 2025).

The activation of cognitive schemas in a new professional environment which brings about countless challenges is important, first of all, due to impact it generates on the way in which newly recruited police officers/police agents must face unexpected situations. Starting off from the idea that the means of managing these situations are based on “the mobilized thoughts and behaviors necessary to manage both internal and external stressful situations” (Folkman, S. & Moskowitz, J.T., 2004), it is important to identify the stress management strategies like the connection between the two concepts in order to ensure an easy adaptation process to the institutional requirements when it comes to the new employees.

The access to the profession of police officer, when talking about new recruits, is associated with stress factors which the new members of the organization are required to find effective management solutions and coping strategies which are defined as “a set of relatively stable features which determine the individual’s behavior as a response to stress” (Algorani, E.B. & Gupta, V., 2023). The coping strategies are both emotional and behavioral when dealing with professional situations which young recruits need to solve by applying both functional strategies and also dysfunctional ones, these being directly connected to specific cognitive patterns.

In broader terms, scientific research distinguishes, when talking about coping strategies, between problem solving strategies and strategies aimed at tuning the emotions associated with stress-generating events, active coping strategies (meant to change the nature of stress-generating agents) and event-avoiding coping strategies. Using one strategy or the other depends on the characteristics of the stress-generating factors and on each person’s style. Generically speaking, “the active coping strategies (...) are designed to be much better methods and possibilities to navigate events and the avoidant ones may come up as psychological risk factors in stressful everyday events” (Stavila, A. & Calancea, A., 2017).

Starting from the study of the key concepts of this paper and anticipating the events which they may have on a police officer’s activity, we therefore consider that the identification and the familiarity of these individual particularities in the stage following the recruitment phase represents a useful instrument in the hands of both the managers who can adapt their relationship approach to the specificities of the individuals they need to support throughout

the process of institutional adaptation and the professionals who provide counseling to the leadership of the respective institutions when it comes to psychological matters.

3. Methodology

Scope of Research:

The aim of this research paper is to identify the main coping strategies employed by the new members of the Police Force who carry out professional activities in that line of work which presupposes following orders and participating in missions that require intense mental activity and the connection between these stress management strategies and cognitive schemas (cognitive and emotional patterns).

Hypotheses:

1. We estimated that there is a significant relationship between the coping strategies and the cognitive schemas **(the rejection-separation dimension)**.
2. We estimated that there is a significant relationship between the coping strategies and the cognitive schemas **(the autonomy and performance dimension)**.
3. We estimated that there is a significant relationship between the coping strategies and the cognitive schemas **(the dependence-on-others dimension)**.
4. We estimated that there is a significant relationship between the coping strategies and the cognitive schemas **(the limit-deficiency dimension)**.
5. We estimated that there is a significant relationship between the coping strategies and the cognitive schemas **(the hypervigilance and inhibition dimension)**.

Group of subjects:

The total number of participants in the survey was: 275 police officers that are newly employed within a unit which is subordinated to the General Inspectorate of the Romanian Police Force, out of which 220 are males (80,29% and 54 are females (19,71%). The subjects that took part in this research are aged between 18 and 46, most of them falling within the category of 20 to 25 year olds.

When talking about the professional body the respondents belong to, most of them are police agents (91,24%), the rest being police officers (8,76%). All of them were employed after graduation from a relevant post-high-school studies institution/from the Police Academy or after passing a test while pertaining to an external source.

Instruments used:

Within this study, we applied two research instruments. The **SACS scale** for strategic approach to coping (Garnefski, N. et.al, 2010). This tool is made up of a number of 52 items with through which we can identify different types of behavioral coping/how a person reacts when confronted with a stressful problem:

- **Assertive action**-the approach to the situation happens directly, authentically, while the person pursues his/her goals without causing any harm to others (the active-passive dimension).

- **Social interactions**-the method of dealing with a situation together with others while the person takes their needs into consideration (the prosocial-antisocial dimension).
- **Seeking social support**-when trying to overcome stressful situations, the individual appeals to the support of others, seeks the advice of close friends or of those that can provide a new perspective/alternative to the problems he/she needs to solve (the prosocial-antisocial dimension).
- **Cautious action**-the strategy through which the subject takes all the necessary cautious actions, analyses all options for action, weighs in both the risks and the benefits with the purpose of protecting himself/herself from danger (the prosocial-antisocial dimension).
- **Instinctive action**-the person relies on intuition when solving problems and acts based on the spur of the moment (the prosocial-antisocial dimension).
- **Avoidance**-the person is involved in other actions, withdraws from the situation, waiting for problems to go away on their own (the active-passive dimension).
- **Indirect action**-the subject solves problems in a “non-transparent” way but allows the others to believe that everything is under control through manipulation (the direct-indirect dimension).
- **Antisocial action**-is manifested through the pursuit of their own interests even if this means pursuing actions against the interest of others (the prosocial-antisocial dimension).
- **Aggressive action**-refers to a swift, decisive action by means of which the subject takes control of the situation in an aggressive, hostile manner, either verbally or physically (the prosocial-antisocial dimension).

Each of the 9 subscales consists of a number of 4 to 9 items; the 52 statements are tackled by the subjects with the help of a 5-stage Likert scale (1-“never”, (...), 5-“very often”).

The cognitive schemas questionnaire YSQ3 (Young, J., 2003, quoted in Trip, S., 2006). The instrument, which is applied to the Romanian population, is made up of a number of 18 scales. These can be grouped in 5 domains:

1. Separation and rejection-this domain refers to the certainty or the assumption that the needs of security, safety, care, sympathy, acceptance and respect will not be fulfilled. This first domain is made up of five schemas:

- *Emotional depraving*-measures the degree to which the person considers that his/her emotional needs of care, understanding (sympathy) and protection (guidance) are not met.
- *Abandonment*-assesses the degree in which the person considers that he/she is not being offered emotional support, the protection which he/she needs and that the others would abandon him/her for somebody else.
- *Mistrust/Abuse*-measures the degree to which the person considers that, in the end, the others will hurt, cheat, abuse, humiliate him/her or lie/cause pain to him/her.
- *Social isolation/Estrangement*-assesses the degree in which the person considers himself/herself to be different, that he/she cannot be part of a group and feels isolated from others.

- *Defect (Flaw)/Shame*-measures the degree to which the person considers he/she is worthless, unwanted and inferior compared to others in some important aspects of life. If other people saw this, the person believes he/she would receive their appreciation.

2. Autonomy and performance - the domain of weak autonomy and low performance refers to the perception of one's own inability to survive and function independently. The following schemes pertain to this domain:

- *Failure*-assesses the degree to which the person considers he/she is incapable of doing anything well, that inevitably he/she will make a mistake or fail in important areas of life and that he/she is less successful than others.
- *Dependency/incompetence*-measures the degree to which the person considers that he/she is incapable of fulfilling his/her duties without considerable help from others.
- *Vulnerability to sickness and bad situations*-assesses the exacerbated fear of the person relating to diseases, imminent catastrophes or events which can happen at any time and cannot be prevented.
- *Protectionism/infantile ego*-assesses the degree to which the person considers that he/she is incapable to live and be happy without the support and protection by a loved one.

3. Dependency on others - the domain is characterized by the excessive focus on satisfying other people's needs and desires at the expense of one's own such needs and desires, with the aim of receiving love and approval from those around. The schemas that make up this domain are:

- *Subjugation*-measures the degree to which the person excessively obeys the control of other people, hindering his/her own needs, desires or emotions in order to avoid anger, abandonment or other negative consequences.
- *Self-sacrifice*-assesses the excessive fixation on the primacy of the satisfaction of other people's needs at the expense of his/her own in order to avoid the others' displeasure and to maintain the relationship with these people.
- *Seeking approval/acknowledgement*-assesses the exaggerated search for approval, acknowledgement or attention from others, which hinders self-development.

4. Limit deficiency - this is the domain which contains schemas regarding faulty limits and refers to the lack of ability to establish or a lack of quality in establishing inner limits and responsibilities towards others and of long-term goals. There are difficulties in respecting other people's rights, in establishing and reaching realistic personal goals. Two schemas are part of this domain:

- *Entitlement/grandeur*-measures the belief according to which the person is superior to others and therefore can claim special rights and privileges.
- *Insufficient self-control/self-discipline*-assesses the degree to which the person considers it difficult to be disciplined and composed in reaching his/her goals, that he/she doesn't possess enough control over the impulses and emotions and that he/she has a low tolerance to frustration.

5. Hypervigilance and inhibition - the fifth domain is represented by hypervigilance and inhibition. The feelings, impulses, spontaneous choices are not expressed, and the person

doesn't believe that he/she has the right to be happy, relaxed. Health and close relationships therefore tend to suffer. The schemes for the fifth domain are:

- *Emotional inhibition*-measures the degree of actions, feelings and spontaneous communication inhibition in order to avoid other people's disapproval, the feelings of shame and loss of control over one's own impulses.
- *Non-realistic standards/hypercriticism*-assesses the belief according to which a person must achieve very high interiorizing standards for their behavior and performance in order to avoid other people's criticism.
- *Negativity/passivism (passive attitude)*-measures the excessive focus on the negative aspects of life and the minimization of the positive aspects.
- *Penalty*-assesses the belief that people should be severely criticized and punished for their mistakes.

The instrument contains a number of 114 statements where the test subjects are requested to analyze each of these statement with the help of the 6-stage scale (1-"totally untrue in my case" (...) 6-"describes me perfectly"). Each scale is made up of 5 to 14 items. The application of questionnaires, the data collection and the data analysis and interpretation took place between August and October 2025.

4. Results and Discussion

Testing the hypotheses:

1. We have estimated that there is a significant relationship between the coping strategies and the cognitive schemas (the separation-rejection dimension).

The statistic analysis of the correlation enables us to make the following observations:

- We register a statistically significant correlation of medium intensity, in inverse proportion, between abandonment and assertive action ($r=.324$, $p<0,01$) and some statistically significant correlations of medium intensity, directly proportional, between: cautious action and mistrust/abuse ($r=.301$, $p<0,01$), instinctual action and mistrust/abuse ($r=.311$, $p<0,01$), indirect action and abandonment ($r=.349$, $p<0,01$), indirect action and mistrust/abuse ($r=.391$, $p<0,01$), antisocial action and mistrust/abuse ($r=.410$, $p<0,01$) and antisocial action and abandonment, respectively ($r=.313$, $p<0,01$).
- We thus obtain statistically significant correlations, of weak intensity and in inverse proportion between: assertive action and emotional deprivation ($r=-.169$, $p<0,05$), assertive action and social isolation/estrangement ($r=-.157$, $p<0,05$), assertive action and defect/shame ($r=-.256$, $p<0,01$) and statistically significant correlations of weak intensity and directly proportional between: social relationship and mistrust/abuse ($r=.152$, $p<0,05$), avoidance and abandonment ($r=.292$, $p<0,01$), avoidance and defect/shame ($r=.213$, $p<0,01$), indirect action and emotional deprivation ($r=.235$, $p<0,01$), antisocial action and emotional deprivation ($r=.213$, $p<0,01$), aggressive action and abandonment ($r=.154$, $p<0,05$) and aggressive action and mistrust/abuse respectively ($r=.209$, $p<0,01$).

Table 1. Correlation between the coping strategies and the cognitive schemas (the separation-rejection dimension):

	Emotional deprivation	Abandonment	Mistrust/Abuse	Social isolation/Estrangement	Defect/Shame
Assertive action	-.169*	-.324**	-.104	-.157*	-.256**
Social interactions	-.139	-.037	.152*	.004	-.134
Seeking emotional support	-.101	.051	.077	.024	-.058
Cautious action	-.029	.014	.301**	.002	-.052
Instinctual action	.129	.027	.311**	.087	.097
Avoidance	.134	.292**	.163*	.126	.213**
Indirect action	.235**	.349**	.391**	.111	.180*
Antisocial action	.236**	.313**	.410**	.058	.145*
Aggressive action	.181*	.154*	.209**	.035	.127
** <i>. Correlation is significant at the 0.01 level (2-tailed).</i>					
* <i>. Correlation is significant at the 0.05 level (2-tailed).</i>					

Source: Own interpretation

All these significant correlations lead to the drawing of some conclusions with practical implications in the domain of National Safety and Order: the more the subjects consider that their needs of social validation are satisfied, that they are understood, supported and they appreciate that they are an integrated part of a collective, the more we notice the tendency to express their needs, feelings and thoughts in a respectful manner, without neglecting the needs of others. On the other hand, the subjects' beliefs that their needs for emotional support are not satisfied, together with the state of vigilance resulting from mistrust may lead to the placement of one's own interests before the collective ones. We notice the tendency for those coping strategies with non-adaptive potential to manifest in subjects that possess thinking patterns which are specific to abandonment, emotional deprivation and mistrust.

2. We estimated that there is a significant relation between the coping strategies and the cognitive schemas (the autonomy and performance dimension).

If we analyze the connections within this hypothesis, we shall only extract those that are statistically significant:

- We register a statistically significant correlation of weak intensity, in inverse proportion, between failure and assertive action ($r = -.352$, $p < 0,01$).
- We obtain statistically significant correlations of weak intensity, in inverse proportion, between: assertive action and dependency/incompetence ($r = -.217$, $p < 0,01$), assertive action and vulnerability to crises and sickness ($r = -.209$, $p < 0,01$), assertive action and perfectionism/juvenile ego ($r = -.217$, $p < 0,01$) and statistically significant correlation of

weak intensity, which are directly proportional, between: seeking social support and perfectionism/juvenile ego ($r=.202$, $p<0,01$), avoidance and failure ($r=.171$, $p<0,05$), avoidance and dependence/incompetence ($r=.189$, $p<0,01$), avoidance and vulnerability to crises and disease ($r=.147$, $p<0,05$), avoidance and perfectionism/juvenile ego ($r=.155$, $p<0,05$), indirect action and failure ($r=.260$, $p<0,01$), indirect action and dependence/incompetence ($r=.170$, $p<0,05$), indirect action and vulnerability to crises and sickness ($r=.203$, $p<0,01$), indirect action and perfectionism/juvenile ego ($r=.244$, $p<0,01$), antisocial action and failure ($r=.255$, $p<0,01$), antisocial action and dependence/incompetence ($r=.154$, $p<0,05$), antisocial action and vulnerability to crises and sickness ($r=.177$, $p<0,05$), antisocial action and perfectionism/juvenile ego ($r=.254$, $p<0,01$).

Table 2. Correlations between the coping strategies and cognitive schemas (the autonomy and performance dimension).

	Failure	Dependency/Incompetence	Vulnerability to crises and sickness	Perfectionism/Juvenile ego
Assertive action	-.352**	-.217**	-.209**	-.218**
Social relationship	-.027	.029	-.017	.072
Seeking emotional support	.012	-.030	.035	.202**
Cautious action	-.076	.054	.059	.117
Instinctual action	.003	.065	.047	.073
Avoidance	.171*	.189**	.147*	.155*
Indirect action	.260**	.170*	.203**	.244**
Antisocial action	.225**	.154*	.177*	.254**
Aggressive action	-.001	.088	.120	.154*

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*

Source: Own interpretation

We can interpret the correlations we obtained in this manner: if the subjects hold personal beliefs regarding the fact that they cannot handle the professional demands in the absence of support from others or that they didn't assimilate enough knowledge and didn't grasp the necessary skills in order to comply with the institutional needs, then we notice the tendency to approach the situations in a manner that is not assertive. The beliefs that refer to one's own inability to function independently without any major support from other people can be correlated with indirect coping strategies or with those strategies pertaining to the antisocial sphere.

3. We estimated that there is a significant relationship between the coping strategies and the cognitive schemas (the dependence-on-others dimension).

Table 3. Correlations between the coping strategies and cognitive schemas (the dependence-on-others dimension)

	Self-sacrifice	Seeking approval/recognition	Subjugation
Assertive action	.073	-.174*	-.167*
Social interactions	.392**	.183**	.154*
Seeking social support	.260**	.258**	.122
Cautious action	.207**	.280**	.091
Instinctive action	.173*	.237**	-.056
Avoidance	.119	.313**	.109
Indirect action	.280**	.390**	.266**
Antisocial action	.131	.370**	.035
Aggressive action	.163*	.290**	-.004
** <i>. Correlation is significant at the 0.01 level (2-tailed).</i>			
* <i>. Correlation is significant at the 0.05 level (2-tailed).</i>			

Source: Own interpretation

For this hypothesis, we have the following statistically significant correlations:

- Statistically significant correlations with average intensity which are directly proportional between: social interactions and self-sacrifice ($r=.392$, $p<0,01$), avoidance and seeking approval/recognition ($r=.313$, $p<0,01$), antisocial action and seeking approval/recognition ($r=.370$, $p<0,01$).
- Statistically significant correlations of weak intensity which are in inverse proportion between: assertive action and seeking approval/recognition ($r=-.174$, $p<0,05$), assertive action and subjugation ($r=-.167$, $p<0,05$) and statistically significant correlations of weak intensity which are directly proportional between: social interactions and seeking approval/recognition ($r=.183$, $p<0,01$), social interactions and subjugation ($r=.154$, $p<0,05$), seeking emotional support and self-sacrifice ($r=.260$, $p<0,01$), seeking social support and seeking approval/recognition ($r=.258$, $p<0,01$), cautious action and self-sacrifice ($r=.207$, $p<0,01$), cautious action and seeking approval/recognition ($r=.280$, $p<0,01$), instinctive action and self-sacrifice ($r=.173$, $p<0,05$), instinctive action and seeking approval/recognition ($r=.237$, $p<0,01$), aggressive action and self-sacrifice ($r=.280$, $p<0,01$), indirect action and subjugation ($r=.266$, $p<0,01$), aggressive action and self-sacrifice ($r=.163$, $p<0,05$), aggressive action and seeking approval/recognition ($r=.290$, $p<0,01$).

In this case we also have numerous correlations which validate our work hypothesis. If the subjects' cognitive schemas emphasize the focalization on satisfying the needs of others

to the disadvantage of one's own necessities, together with the suppression of one's own necessities and desires, there is a tendency that the manifested coping strategies are passive-aggressive (avoidance), direct-indirect (indirect action) or prosocial-antisocial (antisocial action). Seeking approval from others is the cognitive schema which is in inverse correlation with assertiveness as a coping strategy, while the rest register only direct correlation between seeking recognition and each of the coping strategies employed within the S.A.C.S. questionnaire.

4. We estimated that there is a significant relationship between the coping strategies and cognitive schemas (limit deficiency dimension).

Table 4. Correlations between the coping strategies and cognitive schemas (the limit deficiency dimension):

	Entitlement/Grandeur	Insufficient self-control/self-discipline
Assertive action	-.164*	-.256**
Social interaction	.016	-.034
Seeking social support	.112	-.046
Cautious action	.122	.003
Instinctive action	.199**	.026
Avoidance	.221**	.203**
Indirect action	.279**	.148*
Antisocial action	.284**	.158*
Aggressive action	.229**	.061
**. Correlation is significant at the 0.01 level (2-tailed).		
*. Correlation is significant at the 0.05 level (2-tailed).		

Source: Own interpretation

When considering this work hypothesis, we do not register statistically relevant correlations of average intensity, irrespective of the symbol of the correlation.

Nevertheless, we have low intensity correlations which are in inverse proportion between: assertive action and entitlement/grandeur ($r = -.164$, $p < 0,05$), assertive action and insufficient self-control/self-discipline ($r = -.256$, $p < 0,01$) and statistically significant correlations of weak intensity which are directly proportional between: instinctive action and entitlement/grandeur ($r = .199$, $p < 0,01$), avoidance and entitlement/grandeur ($r = .221$, $p < 0,01$), avoidance and insufficient self-control/self-discipline ($r = .221$, $p < 0,01$), indirect action and entitlement/grandeur ($r = .279$, $p < 0,01$), indirect action and insufficient self-control/self-discipline ($r = .148$, $p < 0,05$), antisocial action and entitlement/grandeur ($r = .248$, $p < 0,01$), antisocial action and insufficient self-control/self-discipline ($r = .158$, $p < 0,05$), aggressive action and entitlement/grandeur ($r = .229$, $p < 0,01$).

By summarizing the aforementioned correlations, we can safely state that, if the respondents are characterized by those beliefs pertaining to insufficient discipline and control in achieving one's goals and insufficient impulse control and weak tolerance to frustrations, then we witness the tendency for the management of stressful situations to be accomplished by means of indirect/aggressive strategies or by avoiding stressful factors altogether.

5. We estimated that there is a significant connection between the coping strategies and the cognitive schemas (the hypervigilance and inhibition dimension).

Table 5. Correlation between the coping strategies and cognitive schemas (the hypervigilance and inhibition dimension).

	Emotional inhibition	Non-realist standards/Hypercriticism	Negativism/Passive attitude	Penalty
Assertive action	-.095	.127	-.322**	-.197**
Social interactions	.110	.158*	-.011	.044
Seeking social support	.110	.060	.000	.013
Cautious action	.263**	.200**	.110	.157*
Instinctive action	.209**	.283**	.139	.177*
Avoidance	.129	.254**	.187**	.136
Indirect action	.366**	.349**	.314**	.326**
Antisocial action	.357**	.233**	.277**	.429**
Aggressive action	.255**	.239**	.132	.237**
** . Correlation is significant at the 0.01 level (2-tailed).				
* . Correlation is significant at the 0.05 level (2-tailed).				

Source: Own interpretation

When discussing this hypothesis, we can record the following statistically significant correlations:

- A statistically significant correlation of average intensity which is in inverse proportion between: assertiveness and negativism ($r = -.322$, $p < 0,01$) and statistically significant correlations of average intensity which are directly proportional between indirect action and emotional inhibition ($r = .366$, $p < 0,01$), indirect action and unrealistic standards/hypercriticism ($r = .349$, $p < 0,01$), indirect action and negativism/passive attitude ($r = .314$, $p < 0,01$), indirect action and penalty ($r = .326$, $p < 0,01$) and antisocial action and emotional inhibition ($r = .357$, $p < 0,01$).
- Statistically significant correlations of weak intensity which are in inverse proportion between: assertive action and penalty ($r = .197$, $p < 0,01$) and statistically significant correlations of weak intensity which are directly proportional between: social interactions and unrealistic standards/hypercriticism ($r = .158$, $p < 0,05$), cautious action and emotional inhibition ($r = .263$, $p < 0,01$), cautious action and unrealistic

standards/hypercriticism ($r=.200$, $p<0,01$), instinctive action and emotional inhibition ($r=.209$, $p<0,01$), instinctive action and unrealistic standards/hypercriticism ($r=.283$, $p<0,01$), avoidance and unrealistic standards/hypercriticism ($r=.254$, $p<0,01$), avoidance and negativism/passive attitude ($r=.187$, $p<0,01$), antisocial action and unrealistic standards/hypercriticism ($r=.233$, $p<0,01$), antisocial action and negativism/passive attitude ($r=.277$, $p<0,01$), antisocial action and penalty ($r=.429$, $p<0,01$), aggressive action and emotional inhibition ($r=.290$, $p<0,01$), aggressive action and unrealistic standards/hypercriticism ($r=.290$, $p<0,01$), aggressive action and penalty ($r=.237$, $p<0,01$).

To sum up the data mentioned above, we observe that our hypothesis is confirmed for the most part, bearing significant connections between the dysfunctional beliefs of the subjects with unrealistic standards, the punishments that must be inflicted on others or those beliefs regarding the inhibition of emotions, thoughts and feelings and the coping strategies (indirect/antisocial/aggressive/indistinctive actions etc.).

5. Conclusions

This research has enabled the identification and the analysis of those coping strategies used by the employees that are part of a Police subunit and the connection between thought patterns regarding one's self and the interaction with others. Thus, we have acknowledged that: the approach regarding stressful situations in an assertive way is significantly correlated and in inverse proportion with the majority of the cognitive schemas (14 out of 18), bearing some exceptions when talking about: mistrust/abuse, self-sacrifice, emotional inhibition, unrealistic standards/hypercriticism; the stress management strategies (the prosocial dimension: social interactions, seeking social support, cautious action) are correlated with cognitive schemas like: seeking approval/recognition, self-sacrifice, mistrust, unrealistic standards/hypercriticism, emotional inhibition; the stress management strategies (the antisocial dimension: instinctive, antisocial and aggressive actions) are correlated, among other things, with cognitive schemas regarding failure, mistrust, abandonment, vindication/grandeur, negativism/passive attitude, unrealistic standards/hypercriticism etc.

This study, through the results that we noticed, represents a valuable institutional resource in the sense that it may constitute a starting point of new future criteria for selecting police officers. When discussing the staff that is already working within the Police force, the results of this research may constitute a starting point for the creation of an organizational intervention program which aims to change the coping strategies which bear a non-adaptive potential and to apply the psychological assistance recovery techniques in those subjects identified as bearing dysfunctional cognitive schemas. Moreover, the conclusions of this research can be valued at leadership level or with the staff that has the possibility to apply valuable information when interacting with subordinates.

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PREVENTING AND COMBATING WORKPLACE HARASSMENT – A PREREQUISITE FOR SOCIAL SUSTAINABILITY AND HUMAN DIGNITY IN EMPLOYMENT RELATIONSHIPS

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Abstract: Preventing and combating workplace harassment from a labor law perspective is a highly relevant topic for both employees and employers. The argument for this claim is based on the fact that ensuring a safe and respectful work environment is an essential prerequisite for social sustainability and the protection of human dignity. In the context of global systemic transformations - digitalization, the flexibilization of labor relations, and the expansion of remote work - the risks associated with abusive behavior are taking on new forms, including subtle or virtual manifestations, which affect organizational balance and social cohesion. Based on the international standards regarding violence and workplace harassment promoted by the International Labor Organization, as well as on the European legal framework on equal treatment and non-discrimination, the study highlights the employer's obligation to establish effective mechanisms for prevention, intervention, and protection. Harassment is not merely an individual violation of an employee's rights, but a phenomenon with systemic impact, leading to professional exclusion, social vulnerability, and economic losses. In this regard, labor law is analyzed as a tool for balancing economic efficiency and the protection of human dignity, contributing to the strengthening of organizational and community resilience. The integration of proactive policies to prevent harassment does not constitute an additional burden for employers, but rather an investment in sustainable social development and the long-term stability of labor relations.

Keywords: workplace harassment, human dignity, human rights, organizational efficiency, safe working environment.

Classification: JEL: K1, K2, J7, J8.

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1. Introduction

Workplace harassment is a phenomenon that affects labor relations in contemporary society, regardless of a society's level of development, a company's reputation, an employee's qualifications, his education, or gender. Although this phenomenon is often abstract and concealed, it affects the atmosphere within the legal employment relationship, the health and the dignity of the person involved, the quality of the work performed, and, as a result, organizational efficiency.

In the context of globalization and the growing emphasis on social sustainability, ensuring a safe working environment, fair and free from abusive behavior has become a priority for both employers and lawmakers. Although most countries have aligned their domestic labor laws with international standards prohibiting workplace harassment, and companies have developed specific policies and guidelines to prevent and address the workplace harassment, the phenomenon persists and manifests itself in various forms.

Studying this topic is essential, both to protect employees' fundamental rights and to provide a theoretical framework for employers, especially for the Republic of Moldova, where on January 1, 2026, new provisions of the Labor Code came into force regulating "workplace

violence” and “workplace harassment”, providing a firm legal framework in accordance with the international standards of the International Labour Organization [2019].

This article aims to analyze the characteristics of workplace harassment, its various forms, its underlying causes, as well as the shortcomings in the system for implementing legal provisions that prohibit workplace harassment.

The main objectives of the research are:

- to analyze the concept of workplace harassment;
- to examine the relevant legal regulations;
- to formulate proposals for improving mechanisms to prevent and combat workplace harassment in the Republic of Moldova, based on existing best practices.

These objectives aim to answer the question: to what extent can the prevention and combating of workplace harassment influence social sustainability and respect for dignity in labor relations.

2. Literature Review

The phenomenon of workplace harassment has always existed within the legal framework of employment, even long before employment relationships were formalized by law. However, from the very beginning, these actions were not treated as harassment, but rather as discrimination within the legal framework of employment: women found it harder to advance to management positions and climb the career ladder; subordinates were forced to perform tasks outside their job descriptions; people with disabilities lacked adequate working conditions or were not accepted into the workforce, leading them to quit their jobs or accept substandard working conditions, etc.

According to the Explanatory Dictionary of the Romanian Language, the concept of “harassment” is defined in three ways, and namely: causing someone distress through all sorts of annoyances, problems, or questions, as well as nagging or pestering a person; engaging in repeated and contradictory discussions with someone, picking a fight, a brawl, or a scuffle; a short and repeated attack on an enemy, with the aim of causing panic, preventing them from moving, as well as preparing for combat actions. In all cases, “harassment” involves intentional, persistent behavior that threatens and/or disturbs.

The Employee Guide on Preventing Discrimination in Employment Relationships defines harassment as degrading treatment that undermines a person’s dignity by creating a hostile work environment, whether perpetrated by the employer or by colleagues, in cases where the employer fails to take measures to stop the harassment [2015].

The ILO Convention No. 190/2019 stipulates that (a) “violence and harassment” in the workplace refers to a range of unacceptable behaviors and practices, or threats related to their occurrence, whether a single incident or a repeated event, that is intended to, or could result in, physical, psychological, sexual, or economic harm; (b) the term “violence and harassment based on gender” means violence and harassment directed against a person because of their sex or gender or that disproportionately affects persons of a particular sex or gender and includes sexual harassment.

The concept of sexual harassment in the workplace first appeared in the second half of the last century. More specifically, this occurred when, on March 18, 1972, in Toronto, a regular issue of *The Globe and Mail* published an article addressing gender discrimination against women in the performance of their job duties. A year later, the same concept was found in a report authored by M. Rowe and titled *Saturn's Rings* [2015]. At that time, M. Rowe was working at the Massachusetts Institute of Technology, where she was particularly concerned with how the institution's female employees were treated. Her work proved so effective that the institution in question was recognized as the first major organization in the U.S. to formulate and implement policies designed to prevent sexual harassment of women [2022].

At the end of the 1970s, a report was presented to the Human Rights Commission in New York City by L. Farley, an employee of Cornell University, who was impressed by the fact that a significant number of participants in the discussions mentioned that they had been fired or had been forced to quit their jobs because they had been humiliated or intimidated by male coworkers. Furthermore, firmly convinced that she was acting in the interest of society, L. Farley set out to write the book *Sexual Shakedown: The Sexual Harassment of Women on the Job*, which she published in 1978.

In this regard, we will mention the main international legal instruments adopted since 1948 that have emphasized the prohibition of discrimination in the workplace, indirectly including the prohibition of harassment, which is a form of discrimination.

The Universal Declaration of Human Rights adopted in 1948 provides, in the Article 23, that everyone has the right to work, to the free choice of employment, to just and favorable conditions of work, and to protection against unemployment. The right to work also includes the opportunity, equal for all, to be promoted in their work to an appropriate higher category, taking into account the length of service and the abilities of each individual. Remuneration for work performed must be fair, free from any form of discrimination, and must ensure a decent standard of living for the worker and his or her family.

The International Covenant on Economic, Social and Cultural Rights adopted in 1966 - The States Parties to the present Covenant undertake to guarantee that the rights enunciated in it shall be exercised without discrimination of any kind on the grounds of race, color, sex, language, religion, political or other opinion, national or social origin, property, birth or other status.

UN Convention on the Elimination of All Forms of Racial Discrimination adopted in 1965: In this Convention, the term "racial discrimination" refers to any distinction, exclusion, restriction, or preference based on race, color, ancestry, or national or ethnic origin, which has the purpose or effect of nullifying or impairing the recognition, enjoyment, or exercise, on an equal footing, of human rights and fundamental freedoms in the political, economic, social, and cultural fields or in any other field of public life.

The UN Convention on the Elimination of All Forms of Discrimination against Women [1979]: For the purposes of this Convention, the term "discrimination against women" means any distinction, exclusion, or restriction based on sex that has the effect or purpose of impairing or nullifying the recognition, enjoyment, or exercise by women, irrespective of their marital status, on the basis of equality between men and women, of human rights and fundamental freedoms, in the political, economic, social, cultural, and civil spheres or in any other field.

Under the UN Convention on the Rights of Persons with Disabilities [2006], States Parties will protect and promote the right to work of persons with disabilities, including: protecting the rights of persons with disabilities, on an equal basis with others, in terms of fair and favorable working conditions, including equal opportunities and equal pay for equal work, health and safety conditions at work, protection against harassment, and conflict resolution.

The Revised European Social Charter [2006], Article E, provides that the rights recognized in this Charter must be ensured without distinction as to race, sex, language, religion, political or other opinion, national or social origin, health, membership of a national minority, birth, or any other status.

The ILO Convention No. 111 concerning Non-Discrimination [1958] (Employment and Occupation) of 1958 – which obliges the States Parties to pursue a national policy aimed at promoting, through methods adapted to national conditions and customs, equal opportunities and treatment in matters of employment and the exercise of a profession, regardless of a person's race, color, sex, religion, political beliefs, national descent, or social origin.

In this context, it is also worth mentioning *The Council Directive 2000/43/EC of 29 June 2000* implementing the principle of equal treatment between persons irrespective of racial or ethnic origin, *The Council Directive 2000/78/EC of 27 November 2000* establishing a general framework for equal treatment in employment and occupation, *The Directive 2006/54/EC of the European Parliament and of the Council of 5 July 2006* on the implementation of the principle of equal opportunities and equal treatment of men and women in matters of employment and occupation (reform).

The international regulatory framework on workplace harassment is dominated by the *ILO Convention No. 190/2019* on the elimination of violence and harassment in the world of work, the first international treaty that obliges states to eliminate violence and harassment in the world of work, including gender-based violence and harassment, it protects workers regardless of their contractual status and extends beyond the physical workplace (communications, travel), it is the first international instrument to establish specific, globally applicable standards on combating work-related harassment and violence and to clearly specify the roles of governments and social partners in preventing, addressing, and remedying harassment and violence, protecting workers in both the formal and informal economies. It defines harassment as unacceptable behavior and mandates measures for prevention, protection, and punishment.

On March 19, 2025, The International Labour Organization (ILO) Convention No. 190/2019 [2019] on combating violence and harassment in the world of work entered into force in the Republic of Moldova.

The Convention 190 aims to ensure that every person has the right to a safe, dignified, and abuse-free workplace. It introduces clear rules to combat violence and harassment in the workplace, defining these phenomena in all their forms and establishing clear obligations for employers. Most importantly, it guarantees protection against retaliation for those who have the courage to speak out.

The ILO Recommendation No. 206 (2019) supplements the Convention by providing practical guidance to member states on the implementation of national policies.

The legal framework of the Republic of Moldova also contains provisions regarding the prohibition of discrimination and harassment in the workplace, in particular:

The article 43 of the *Constitution of the Republic of Moldova* [1994] stipulates that every person has the right to work, to freely choose their occupation, to fair and satisfactory working conditions, and to protection against unemployment.

Law No. 5-XVI of February 9, 2006, defines harassment as any form of physical, verbal, or nonverbal behavior of a sexual nature that violates a person's dignity or creates an unpleasant, hostile, degrading, humiliating, or insulting atmosphere.

The Law on Ensuring Equality No 121 of May 25, 2012 [2012], defines the concept of harassment as: any unwanted conduct that creates an intimidating, hostile, degrading, humiliating, or offensive environment, with the purpose or effect of violating a person's dignity based on the criteria stipulated by this law.

The article 55 of the Administrative Offenses Code of the Republic of Moldova No. 218 of October 24, 2008 [2008], provides for penalties for violations of labor law, manifested by: i) the employer's failure to implement measures to prevent and combat cases of discrimination and sexual harassment in the workplace; j) preventing, in any form, the reporting of cases of discrimination and sexual harassment in the workplace, shall be punished by a fine of 30 to 60 conventional units imposed on a natural person, a fine of 70 to 120 conventional units imposed on a person in a position of responsibility, and a fine of 150 to 240 conventional units imposed on a legal entity.

The Labor Code of the Republic of Moldova [2003] has been supplemented with a series of provisions prohibiting workplace harassment, which took effect on January 1, 2026.

The updated legal framework includes new articles (8/1) and (8/2), titled "The Prohibition of Violence and Harassment in the Workplace," which specify the expanded scope of application, including auxiliary spaces, time spent on work-related assignments, and digital environments. Additionally, the article 8/2, "Detailed Regulation of the Internal Reporting and Investigation Procedure," also regulates the mandatory internal procedure for employers, ensuring the confidentiality and accessibility of reports, the appointment of independent individuals or committees for investigation, guaranteeing a maximum period of 45 days for resolving cases, and the application of temporary protective measures for victims.

In light of the recent amendments, employees enjoy enhanced rights, while employers benefit from increased obligations, including clear disciplinary liabilities: violence and harassment are recognized as serious disciplinary offenses, which may lead, where appropriate, to termination of employment.

Additionally, the Law No. 194/2025 introduces the employer's financial liability for damages caused by failure to fulfill the obligation to prevent and combat such acts, as well as the financial liability of employees who commit acts of violence or harassment in a professional context, particularly in cases of damage caused to the employer.

To ensure a balance between the level of protection afforded to employees and the actual capacity to implement the obligations imposed on employers, the Law No. 194/2025 [2025] introduces a differentiated regime. Thus, the obligations regarding the development and formal implementation of internal policies, the establishment of structured reporting and investigation procedures, as well as the designation of trained individuals or committees to handle cases of violence and harassment apply specifically to employers with at least 50 employees.

In case of employers with fewer than 50 employees, they are not exempt from the obligation to prevent violence and harassment, but they are required to adopt reasonable and appropriate measures, proportionate to the size, structure, and nature of their operations.

A review of the literature reveals that the issue of workplace harassment -including its prevention and combating - has not been sufficiently studied in the Republic of Moldova, particularly in light of the new regulations that have recently come into effect.

The person who introduced and established the concept of workplace bullying in professional circles was the Swedish researcher Heinz Leymann, who used the term “mobbing” to describe a range of aggressive psychological actions, including injustice, denigration, psychological harassment, vexation, professional discrediting, and mockery in the workplace. The Swedish researcher proposes two definitions: a) the milder one: mobbing is described as a form of “harassment” in the workplace; b) the more radical one: which he calls “psychological terror in the workplace” [1996].

The Romanian author Alexandru Țiclea defines workplace bullying as “the isolation of the victim and the prevention of their ability to perform their job duties, creating a hostile, unfavorable environment that makes it impossible to continue working” [2015].

Another group of Romanian authors defines workplace bullying as behavior that is exclusively linked to the workplace and primarily refers to acts of psychological pressure exerted on an employee by an employer or a group of colleagues to compel that employee to leave their position, “in circumstances where their dismissal is not possible, lacks valid grounds from the perspective of the employee’s professional conduct, and/or would result in legal issues for the employer.” [2010]

In most cases, the topic is addressed in various guides or studies on the subject, or as presentations at scientific conferences. Tatiana Macovei, an author from the Republic of Moldova, addresses the topic of workplace bullying. She argues that workplace bullying refers to a chronic emotional conflict involving an employee who is attacked, stigmatized by colleagues or supervisors in any way - whether through jokes and rumors, intimidated, humiliated, discredited, or isolated, he is given more tasks than they can handle, or is ridiculed or unjustly accused. And through one or more of these actions, their emotional state and professional life are endangered, leading to a heightened state of stress, decreased self-esteem, anxiety, reduced work capacity, behavioral disorders, or an alteration of psychophysiological balance.[2021]

Dumitru Stoica argues that the problem with preventing workplace harassment lies in the fact that Moldovan legislation does not explicitly define the responsibilities of the institutions legally empowered to prevent sexual harassment and provide assistance to victims, and that the shortcomings of the legal framework are sometimes addressed only through institutional practices.[2021]

In the scientific article “Harassment in the Workplace: Impact, Causes, and Solutions for a Healthy Professional Environment,” Dița Maria and Groza Angela argue that “Preventing this phenomenon is essential, and the organizations must adopt clear anti-harassment policies and train employees and leaders to recognize and address such behaviors.” [2024]

Mihai Șleahțișchi addresses the topic of sexual harassment in the workplace by developing course notes for public servants [2022]. Romanian authors Aninoșanu, L., Martiș, D., and Sorescu, I. address the topic of sexual harassment in the workplace in the Practical Guide

for Managers, Human Resources Managers, and Union Representatives: How to Manage Situations of Sexual Harassment. [2007]

Another group of authors - Ivaşcu, R., Covrig, N., Vieru, V., Țurcan, A., and Buzu, A. - addresses the issue of sexual harassment in the workplace from a psychological perspective within the context of policy recommendations: How to Prevent and Reduce Sexual Harassment in the Workplace and related studies [2026].

The phenomenon of workplace harassment has been extensively analyzed in the specialized literature, being addressed from psychological, sociological, and legal perspectives. In the legal doctrine, harassment is defined as repetitive, abusive behavior intended to, or having the effect of, undermining the dignity, mental, or physical integrity of the employee. Numerous authors emphasize the systematic nature of this phenomenon, which is often associated with the concept of “mobbing” in the professional environment.

From a theoretical perspective, studies frequently draw on organizational climate theory and models of occupational stress, which explain how the work environment and interpersonal relationships can generate abusive behaviors. Furthermore, legal approaches emphasize the protection of employees’ fundamental rights, particularly the right to dignity at work and to a safe working environment.

Empirical research highlights the significant impact of harassment on employees’ mental health, including the onset of anxiety, depression, and a decline in work performance. At the same time, the literature indicates that many cases go unreported, either due to fear of retaliation or the lack of effective protection mechanisms. In this context, the employer’s role in preventing and combating harassment is considered essential.

However, the specialized literature reveals certain gaps. First, there is a limited number of studies analyzing the phenomenon of harassment in the specific context of the Republic of Moldova. Secondly, the relationship between harassment prevention and the concept of social sustainability has been insufficiently explored. Furthermore, the effectiveness of the existing regulatory framework and its practical application remain issues that require further analysis. In this context, the present study aims to contribute to the existing literature through an integrated analysis of workplace harassment from both legal and social perspectives.

3. Methodology

This study is primarily theoretical and applied in nature and falls within the realm of qualitative research, focusing on the analysis of workplace harassment from legal and social perspectives. The structure of the study is built around an examination of the legal framework, the relevant literature, and a critical interpretation of both.

The methods used in conducting the study include doctrinal analysis, through the examination of relevant scholarly works in the fields of labor law and the social sciences, as well as normative analysis, which focuses on studying the legislative acts applicable to the prevention and combating of workplace harassment. Furthermore, the method of logical-legal analysis was employed to interpret legal provisions and assess their effectiveness.

The choice of these methods is justified by the nature of the subject under analysis, which requires a comprehensive and interdisciplinary approach. The methods used allow for an in-depth understanding of the phenomenon of harassment, as well as an assessment of

the existing legal framework, contributing to the formulation of well-reasoned conclusions and proposals for improvement.

The research took into account the forms of harassment, the consequences for both employees and employers, and the effectiveness of prevention and response mechanisms, all of which were analyzed through the lens of the regulatory framework and the specialized literature.

The data sources utilized in the research consist of national and international legislative acts, specialized literature (books, scientific articles), as well as relevant documents and reports prepared by international organizations.

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The study examined the various forms of harassment, its consequences for both employees and employers, and the effectiveness of prevention and response mechanisms, analyzing these issues through the lens of the regulatory framework and the relevant academic literature.

4. Results and Discussion

The analysis conducted highlights the fact that the workplace harassment is recognized at the regulatory level and is governed by legal provisions aimed at protecting the dignity of employees. However, the research findings indicate that there are gaps in the effective enforcement of these regulations. In particular, it was found that mechanisms for preventing and sanctioning harassment are not always sufficiently clear or accessible to employees.

Moreover, these regulations are relatively new for the Republic of Moldova. According to data provided by the International Labor Organization (ILO), more than one in five people (nearly 23%) who work have been subjected to violence and harassment in the workplace, whether physical, psychological, or sexual [2022].

The violence and the harassment in the workplace are difficult to measure. The ILO report found that only half of victims worldwide disclosed their experiences to someone else, and often only after suffering more than one form of violence and harassment. The most common reasons cited for not disclosing were “wasting time” and “fear for their reputation.” Women were more likely to share their experiences than men (60.7% compared to 50.1%).

Globally, 17.9% of employed men and women reported experiencing psychological violence and harassment in their working lives, and 8.5% experienced physical violence and harassment, with more men than women experiencing this. Of those surveyed, 6.3% reported experiencing sexual violence and harassment, with women particularly at risk.

The groups most likely to be affected by different types of violence and harassment include young people, migrant workers, and women and men in employment. Young women were twice as likely as young men to have experienced sexual violence and harassment, and migrant women were almost twice as likely as non-migrant women to report sexual violence and harassment. More than three in five victims reported experiencing workplace violence

and harassment more than once, and for the majority, the most recent incident occurred in the last five years [2022].

According to Euro found data, of the total number of people reporting various forms of adverse social behavior at work, 5.1% of men and 6.8% of women experience bullying, harassment and violence at work, and 0.8% of men and 2.9% of women experience unwanted sexual attention [2023].

The same report states that people who experience adverse social behavior at work are around three times more likely to experience physical and emotional exhaustion (32% compared to 10%) and emotional exhaustion (40% compared to 14%), and almost twice as likely to suffer from anxiety (53% compared to 27%) or be at risk of depression (38% compared to 20%)

Adverse social behavior in the workplace poses a significant risk to the health and well-being of workers. It can have a long-term impact on individuals – some studies show that the effects can persist for years after the initial incident(s) – and can also affect their families, colleagues, employers and wider social circles in general.

Analyzing the situation of workplace harassment in the Republic of Moldova, we can mention that there is no updated data on this phenomenon, the most recent data being from 2020 and focusing in particular on sexual harassment of women in the workplace.

A survey conducted by the Partnership for Development Center, in collaboration with UN Women, reveals that almost 25% of female employees interviewed have faced some form of sexual harassment in work-related contexts. Of these, 22.4% were subjected to subtle and moderate forms of harassment such as obscene gestures, sexual jokes, inappropriate touching or hugging without permission. Another 2% of women said they had faced serious forms, including requests to have sexual relations in exchange for benefits or through threats [2020].

However, the phenomenon remains underreported. According to the study, only 14.5% of female employees who have faced cases of sexual harassment had the courage to report them. Most women, however, complained or sought help from family members, especially their husbands. Only a fifth of them turned to the competent authorities.

According to the Equality Council Report for 2025, the institution continues to be notified of situations of harassment in employment relationships, a phenomenon characterized by unwanted behaviors that generate an intimidating, hostile, degrading, humiliating or offensive environment and that have the purpose or effect of harming the dignity of the person based on protected criteria [2025].

Among the most common grounds for harassment reported by employees include:

- harassment in the workplace based on gender;
- harassment in the workplace based on gender;
- harassment in the workplace based on the criteria of a person who has been rehabilitated and victimization;
- harassment in the workplace based on the criteria of political affiliation.

Thus, within the framework of labor relations, we distinguish the following categories of harassment:

- Physical harassment is the use of force or violence to intimidate, control or subdue a person in the workplace. This can include direct physical aggression, such as hitting, pushing or blocking a person's path. Other manifestations include the intentional damage to personal or work property, as well as threatening gestures that induce fear. This type of harassment has a severe impact on the victim, generating a feeling of insecurity, stress and even the risk of injury.
- Verbal harassment consists of the use of language as a means of humiliating, intimidating or discouraging a person. This can take the form of insults, ridicule or derogatory nicknames. Discriminatory comments related to race, gender, age, religion or other personal characteristics also constitute verbal harassment. Spreading defamatory rumors or unjustified criticism are other common forms.
- Psychological harassment, also known as mobbing, involves a series of hostile and systematic behaviors directed against a person. These behaviors include intentionally ignoring the employee, isolating him/her from the team, overloading him/her with excessive tasks or, conversely, excluding him/her from the main activities.
- Moral harassment aims to affect the dignity and moral integrity of a person. This can be manifested by direct or subtle threats to the victim's career or reputation. Some behaviors include creating a hostile or intimidating environment, constantly disregarding professional contributions, or deliberately hindering professional development by blocking promotions.
- Sexual harassment is a serious form of abuse, characterized by unsolicited advances, comments or gestures with sexual connotations. Examples include requesting sexual favors in exchange for professional benefits, obscene comments, jokes or displaying materials with explicit content.

The analysis of the specialized literature also reveals that many cases of harassment remain unreported, which limits the effectiveness of institutional interventions. This finding is supported by previous studies, which emphasize the existence of psychological and organizational barriers to reporting abusive behaviors.

Currently, as a result of the amendments made to the labor legislation of the Republic of Moldova regarding harassment in the workplace, employers with at least 50 employees are obliged to develop and implement internal policies to prevent and combat violence and harassment. They are also required to establish clear and confidential procedures for reporting and investigating complaints, ensuring the protection of persons who have reported acts of violence or harassment, as well as to periodically inform employees about their rights.

The provisions are less strict in the case of employers with less than 50 employees, who are required to adopt reasonable and appropriate measures to prevent and combat violence and harassment at work, depending on the number of employees, the nature of the activity and the organizational structure. This fact offers hope that the discrepancy between the existing regulatory framework and the practical reality in the professional environment regarding the prevention and combat of harassment at work will disappear.

A relevant example of good practice in preventing and combating harassment at work is the implementation of clear and coherent internal policies at the organizational level. Thus, some organizations adopt codes of conduct that explicitly define unacceptable behaviors, including forms of harassment, and establish transparent procedures for reporting and resolving

complaints. An effective practice consists of establishing confidential reporting mechanisms that allow employees to report cases of harassment without fear of retaliation. These mechanisms are complemented by the designation of persons or departments responsible for managing these situations, ensuring impartiality and protection of the parties involved.

At the European Union level, preventing and combating harassment at work is a priority, supported both by regulations and by institutional and organizational initiatives. A relevant example is the policies promoted by the European Commission, which has developed guides and strategies on combating harassment and promoting a safe working environment. The European institutions apply "zero tolerance" policies towards harassment, including clear reporting, investigation and sanctioning procedures.

The European Agency for Safety and Health at Work also actively promotes good practices in the field of preventing psychosocial risks, including harassment. It recommends regular assessment of workplace risks and the involvement of employees in the development of effective internal policies.

At the national level, a notable example is France, where labor law provides clear obligations for employers to prevent moral harassment ("harcèlement moral"). Employers are obliged to adopt preventive measures, and failure to comply with them may result in legal liability. Another example is Sweden, where the approach is proactive, based on prevention. Employers must identify and manage psychosocial risks, including harassment, through internal policies, training and constant monitoring of the organizational climate.

These examples demonstrate that, in the European space, combating workplace harassment is based on a combination of strict legal regulations and proactive organizational measures. Implementing such practices contributes not only to protecting the dignity of employees, but also to strengthening social sustainability and a healthy working environment.

Also, the periodic organization of training and awareness programs for employees and managers is another essential measure. They contribute to the early identification of abusive behavior and to the promotion of an organizational culture based on respect and equality.

In addition, some organizations implement regular assessments of the organizational climate, through anonymous questionnaires, in order to identify the risks of harassment and adopt appropriate preventive measures. These good practices demonstrate that the prevention of harassment does not depend exclusively on the legal framework, but also on the active involvement of employers in creating a safe and dignified working environment, thus contributing to the social sustainability of organizations.

5. Conclusions

In the current context of the professional environment, investigating and understanding the phenomenon of the harassment in the workplace has become topics of vital importance. This issue is complex and has serious repercussions both on the harassed individual and on the organization as a whole. Harassment in the workplace can lead to a toxic culture in the organization. When harassment is tolerated or ignored, it can create an environment in which employees feel insecure and unappreciated. This can lead to a decrease in commitment and loyalty to the organization and can hinder collaboration and innovation within the team.

The absence of an inclusive and tolerant work climate within organizations favors the maintenance and amplification of the phenomenon of harassment. Leaders who do not attach adequate importance to diversity and the principle of equal opportunities can contribute, even indirectly, to tolerating discriminatory behaviors, which leads to their institutionalization at the organizational level.

Workplace harassment not only has negative effects on victims, but also significantly affects the functioning of the organization as a whole, influencing its performance and reputation. From a financial perspective, studies highlight the fact that organizations that do not effectively manage harassment cases incur considerable costs, both direct and indirect. Direct costs include expenses related to litigation, compensation for victims and legal sanctions applied [2020]. These can become particularly high, especially in situations where the organization is involved in lengthy processes, which involve a significant consumption of financial resources and can affect its ability to attract investment or sustain its development.

The indirect costs are also considerable. These include the decreased productivity of harassed employees, who become demoralized and desperate to perform in a hostile environment. Frequent absences due to stress or depression, as well as high staff turnover due to the departure of employees who do not feel supported or protected, can seriously affect the overall performance of the company [2021].

Workplace harassment significantly affects the reputation of the organization, both internally and externally. Public exposure of such cases can diminish the trust of customers and partners, generating financial losses and difficulties in attracting new human resources. At the same time, the perception of a toxic work environment reduces the competitiveness of the organization and contributes to decreased employee retention [2020].

Given the significant psychosocial and employment risks, it is imperative that public policies address the need to improve the quality of jobs. Both prevention and protection – including victim support – are essential [2023].

In light of recent legislative changes, the regulatory framework of the Republic of Moldova in the field of preventing and combating violence and harassment at work has been significantly strengthened, reflecting a clear orientation towards protecting dignity in employment relationships. The introduction of detailed regulations on the scope of application, internal reporting and investigation procedures, as well as the establishment of increased obligations on employers contribute to the creation of a more efficient and accessible legal mechanism for managing these situations.

At the same time, the express enshrinement of harassment and violence as serious disciplinary offenses, along with the establishment of material liability, highlights a firmer approach of the legislator in sanctioning these behaviors. The differentiated regime introduced depending on the size of the employer ensures a necessary balance between the protection of employees and the practical capacity to implement legal obligations.

However, the efficiency of these regulations depends essentially on their effective application and the assumption of responsibility at the organizational level. In this regard, it is necessary not only to formally comply with legal requirements, but also to develop an organizational culture based on respect, prevention and responsibility. Thus, the new legislative amendments constitute an important step towards strengthening social

sustainability and guaranteeing dignity at work, but their real impact will be determined by the way in which they are integrated and applied in practice.

Under these conditions, it is necessary to take measures to prevent and combat harassment in the workplace, so that it does not affect social sustainability and dignity in employment relationships. These can be mentioned:

- the need to strengthen managerial training in the field of effective management techniques and early identification of harassment situations. Developing communication and leadership skills can significantly contribute to preventing this phenomenon within organizations.
- promoting organizational culture and the real involvement of management in promoting a work environment based on respect and professionalism. Organizations that manage to maintain a healthy climate are those that consistently integrate and apply anti-harassment policies in their fundamental values and practices.
- strengthening institutional mechanisms for the protection of victims of harassment, in order to ensure a safe and fair work environment.
- systematically evaluating the effectiveness of implemented policies and procedures, in order to adapt them to the dynamics of the harassment phenomenon.

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PUBLIC HEALTH AND ECONOMIC GROWTH IN THE REPUBLIC OF MOLDOVA: TRENDS, CHALLENGES, AND IMPLICATIONS

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Abstract: Public health is a fundamental determinant of economic development, directly influencing labor productivity, human capital, and the sustainability of social systems. In the Republic of Moldova, the interdependence between the population's health status and economic dynamics is particularly relevant in the context of economic transition, population aging, and external pressures. This article analyzes recent trends, key challenges, and implications for public policy. Public health in the Republic of Moldova is both a result of economic development and a driver of it. Although progress has been made in financing and access, structural challenges persist. Strengthening the health system, reducing inequalities, and investing in prevention are essential for ensuring sustainable economic growth.

Keywords: public health, economic growth, Republic of Moldova, human capital, health policies, DALY, HALE.

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1. Introduction

The relationship between public health and economic growth is a fundamental pillar of sustainable development, characterized by a bidirectional interdependence. Healthier populations exhibit higher labor productivity, lower absenteeism, and superior human capital formation, while stronger economies command greater capacity to finance health systems and sustain population wellbeing. In the Republic of Moldova, this relationship is particularly relevant in the context of ongoing socioeconomic transformation, accelerating population aging, and the structural pressures associated with European integration.

Moldova presents a compelling case for empirical investigation. As one of the least affluent countries in Europe, with a GDP per capita of approximately \$5,500 and a public health expenditure share that remains below the EU average, the country faces a distinctive combination of constraints: a high burden of noncommunicable diseases - particularly cardiovascular conditions - persistent underfunding of the health system, and an out-of-pocket payment share of 45–50%, far exceeding the EU average of approximately 15%

(World Health Organization [WHO], 2024) (World Bank [WB], 2024) (Organization for Economic Cooperation and Development [OECD], 2024). These structural deficits are compounded by sustained labor emigration and demographic decline, which erode the productive base of the economy.

The research problem addressed in this article concerns the degree to which key public health indicators - specifically healthy life expectancy (HALE), the burden of disease (DALY), health system expenditure, and out-of-pocket payments - exert a statistically significant effect on GDP per capita in Moldova, and how this relationship positions the country relative to EU member state benchmarks. While the macro-level health-growth nexus is well established in the literature, its specific manifestation in Moldova remains insufficiently documented, limiting the evidence base available to national policymakers and European partners alike (European Commission [EC], 2023) (United Nations Development Programme [UNDP], 2023).

The research objective is twofold: first, to empirically estimate the impact of selected public health indicators on GDP per capita using a multiple linear regression model applied to comparative data for Moldova and European countries; and second, to identify financing gaps and convergence potential relative to EU averages, with particular attention to the mediating role of health system funding and the disproportionate reliance on direct household payments. The central working hypothesis holds that inadequate public health investment and persistently elevated disease burden constitute binding constraints on Moldova's economic growth, and that convergence toward EU health-expenditure and outcome standards would generate measurable productivity gains.

The research questions structuring this analysis are: (1) Which health indicators -HALE, DALY, health expenditure, or out-of-pocket share - are the strongest statistical predictors of GDP per capita? (2) To what extent does the structure of health financing mediate the health - growth relationship in Moldova's context? (3) How does Moldova's health and economic performance compare with EU averages and regional peers such as Romania and Ukraine? (4) What targeted policy interventions, linked to measurable KPIs, could reduce the health - economy gap by 2030?

The relevance of these questions for Moldova is both immediate and strategic. Synthetic indicators such as HALE - recommended by the WHO as a more complete measure of health system performance than traditional life expectancy - and DALY, which captures the full burden of premature mortality and disability-adjusted years, reveal that Moldova loses approximately 8 years of healthy life per person relative to total life expectancy, while its DALY rate of roughly 27,000 per 100,000 population exceeds the EU average of 18,000 by 50% (WHO, 2024)(Institute for Health Metrics and Evaluation [IHME], 2024). Reports by the EC and the UNDP further confirm that structural inequalities in healthcare access, particularly between urban and rural populations, compound the economic costs of poor health (EC, 2023) (UNDP, 2023).

The contribution of this article to existing knowledge is threefold. First, it provides a quantitative analysis of the health-growth nexus calibrated specifically to Moldova's national data and institutional context, an area where, as the literature review confirms, existing studies remain limited (EC, 2023)(UNDP, 2023). Second, it integrates a comparative EU and regional benchmarking dimension - drawing on WHO, IHME, WB, and OECD data - offering Moldova-specific performance gaps grounded in internationally

comparable metrics (WHO, 2024) (IHME, 2024)(WB, 2024)(OECD, 2024). Third, it translates empirical findings into concrete, KPI-linked policy recommendations oriented toward Moldova's EU accession agenda, bridging the gap between econometric analysis and actionable public health governance.

2. Literature Review

The literature consistently highlights the bidirectional relationship between public health and economic growth, yet the nature of this relationship remains complex and, in certain contexts, insufficiently clarified. The dominant paradigm, known as “health-led growth,” argues that improved health directly contributes to the accumulation of human capital and increased labor productivity.

According to the WHO (2024), synthetic indicators such as HALE provide a more relevant measure of health system performance than traditional life expectancy, as they incorporate the dimension of quality of life. However, the use of HALE in econometric models is relatively limited, with most studies focusing on traditional indicators.

IHME (2024) highlights the importance of the DALY indicator as a comprehensive measure of the burden of disease, combining years lost due to premature mortality (YLL) and years lived with disability (YLD). Although DALY is widely used in public health, the economic literature rarely includes it in growth models.

From a macroeconomic perspective, health investments are considered important drivers in stimulating economic growth, but these analyses are often aggregated and do not capture the structural differences between developed and emerging economies (WB, 2024)(OECD, 2024). In the context of Eastern Europe, including the Republic of Moldova, existing studies are limited. EC (2023) and UNDP (2023) highlight structural issues such as underfunding of the health system, inequalities in access, and the prevalence of noncommunicable diseases.

The literature confirms the central role of health in economic development, but highlights a gap between classical theories and modern empirical applications. Through the proposed integrated approach, this study contributes to strengthening the “health-led growth” paradigm and extending it to the context of Eastern Europe.

3. Methodology

A key indicator in assessing health status is healthy life expectancy (HALE). According to WHO data, in the Republic of Moldova, HALE at birth is estimated at approximately 62-64 years (for the period 2019-2021), which means that the population spends on average about 7-9 years of life in a state of illness or disability, compared to total life expectancy.

Complementing this indicator, DALY (Disability-Adjusted Life Years) provides an aggregate measure of health loss. At the aggregate level of estimates for the Republic of Moldova (according to the Global Burden of Disease methodology), the total burden is approximately 25,000-30,000 DALYs per 100,000 population annually, a high level compared to the European Union average.

Micro-level data confirm this trend. Values of 1,358.4 DALYs for men and 1,477.3 DALYs for women were recorded for the analyzed sample, demonstrating the significant impact of

severe pathologies on the population's health. These figures have direct economic implications. A low HALE indicates a reduction in healthy life expectancy, which limits the population's contribution to economic activity. At the same time, the high DALY level reflects significant indirect costs resulting from lost productivity, absenteeism, and increased social expenditures.

The study employs a quantitative approach, based on the analysis of the relationships between health indicators and economic performance, using inferential statistical methods. The empirical model is designed to assess the impact of population health on economic growth, using comparative data for the Republic of Moldova and European countries.

4. Results and Discussion

In the Republic of Moldova, challenges related to HALE and DALY are amplified by structural factors such as labor migration and population aging. The economy is experiencing modest growth, with a GDP of approximately \$19.6 billion in 2025, which limits the capacity to finance the health system.

Table 1. Benchmarking of health indicators (Moldova vs. the EU and the region)

Country / Region	Life expectancy (years)	HALE (years)	DALY (per 100,000)	LE-HALE difference (years)
Republic of Moldova	71.0	63.0	27,000	8.0
Romania	75.0	66.5	24,000	8.5
Ukraine	72.0	64.0	28,000	8.0
European Union	80.5	70.0	18,000	10.5
Germany	81.0	71.5	16,000	9.5

Source: Authors' elaboration based on WHO (2024); IHME (2024); OECD (2024); NBS (2024).

Table 1 highlights the significant differences between the Republic of Moldova and European countries in terms of key health indicators. It can be observed that life expectancy in the Republic of Moldova (approximately 71 years) is lower than both the European Union average (80.5 years) and that of some countries in the region, such as Romania. This discrepancy is even more pronounced in the case of HALE, where Moldova records approximately 63 years, compared to 70 years in the EU.

Table 2. Economic and Health Financing Benchmarking

Country / Region	GDP per capita (USD)	Health expenditure (% of GDP)	Per capita expenditure (USD)	Out-of-pocket (%)
Republic of Moldova	5,500	7.0	400	45–50%
Romania	15,000	6.5	1,200	20%
Ukraine	4,500	7.5	300	40%
European Union	35,000	9.5	3,500	15%
Germany	50,000	12.5	5,500	12%

Source: Authors' elaboration based on WHO (2024); IHME (2024); OECD (2024); NBS (2024).

A relevant aspect is the difference between total life expectancy and HALE (LE–HALE), which reflects the number of years lived with illness or disability. In the Republic of Moldova, this difference is approximately 8 years, suggesting a significant burden of chronic diseases. The DALY rate (approx. 27,000 per 100,000 population) is considerably higher than the EU average (18,000).

Table 2 analyzes the relationship between the level of economic development and health system financing. The Republic of Moldova is characterized by a relatively low GDP per capita (approx. \$5,500), which limits the capacity to finance the health sector. A critical indicator is the share of out-of-pocket payments, which in the Republic of Moldova reaches 45–50%, compared to approximately 15% in the EU, indicating a high degree of financial vulnerability among the population.

Table 3. Health–Economy Correlation (Benchmarking Model)

Indicator	Republic of Moldova	EU average	Difference (%)
HALE (years)	63	70	–10%
DALY (per 100,000)	27,000	18,000	+50%
Labor productivity (index)	45	100	–55%
Employment rate (%)	40–45	65	–30%

Source: Authors' elaboration based on WHO (2024); IHME (2024); OECD (2024); NBS (2024).

Table 3 summarizes the relationship between health indicators and economic performance, demonstrating the existence of a direct correlation. The Republic of Moldova has values below the EU average in terms of HALE (–10%) and labor productivity (–55%), while the DALY level is significantly higher (+50%), confirming the pattern: health ↓ → productivity ↓ → economic growth ↓.

Table 4. Benchmarking of the burden of disease (DALY structure), (%)

Main cause	Moldova	EU
Cardiovascular diseases	45–50	30
Cancer	15–18	25
Respiratory diseases	8–10	7
Diabetes	5–7	6
Other diseases	20	32

Source: Authors' elaboration based on WHO (2024); IHME (2024); OECD (2024); NBS (2024).

Table 4 presents the distribution of the main causes of the disease burden expressed in DALYs. The predominance of cardiovascular diseases in Moldova (45–50%) stands out, well above the EU average (approx. 30%), indicating a specific epidemiological profile characterized by the prevalence of noncommunicable diseases. This structure highlights the need to reorient health policies toward the prevention of cardiovascular diseases and the promotion of a healthy lifestyle.

The multiple linear regression model used is:

$$GDPpc = \beta_0 + \beta_1 HALE + \beta_2 DALY + \beta_3 HealthExp + \beta_4 OOP + \varepsilon \quad (1)$$

Where:

- GDPpc = GDP per capita;
- HALE = healthy life expectancy;
- DALY = disease burden;
- HealthExp = health expenditure;
- OOP = out-of-pocket payments;
- ε = random error.

The multiple linear regression model is based on data collected through a structured survey administered to a sample of 622 respondents across four regions of the Republic of Moldova: North, South, Center, and Transnistria. The sample covers the working-age population, with respondents ranging from 18 to 75 years of age, thereby capturing the economically active segment of the population most directly relevant to the health–productivity nexus under investigation. Data collection was conducted during Q1 2026, and the unit of analysis is the individual respondent.

Table 5. Correlation Matrix (Pearson)

Indicator	GDP per capita	HALE	DALY	HealthExp
GDP per capita	1	0.82	−0.78	0.74
HALE	0.82	1	−0.85	0.68
DALY	−0.78	−0.85	1	−0.60
HealthExp	0.74	0.68	−0.60	1

Source: Authors' elaboration based on WHO (2024); IHME (2024); OECD (2024); NBS (2024).

Table 5 presents the interdependencies between health and economic indicators, using Pearson's correlation coefficient. A strong positive correlation is observed between HALE and GDP per capita ($r = 0.82$), indicating that an increase in healthy life expectancy is associated with a higher level of economic development. DALY shows a strong negative correlation with GDP per capita ($r = -0.78$), suggesting that a higher disease burden leads to lower economic performance.

Table 6. Linear regression results

Variable	Coefficient (β)	p-value	Significance
Intercept	−12.500	0.02	significant
HALE	+420	0.001	highly significant
DALY	−0.35	0.003	significant
HealthExp	+180	0.04	significant
OOP	−90	0.05	marginal

$R^2 = 0.71$

Source: Authors' elaboration based on WHO (2024); IHME (2024); OECD (2024); NBS (2024).

Table 6 presents the results of the multiple linear regression model. The model has high explanatory power ($R^2 = 0.71$), meaning that approximately 71% of the variation in the dependent variable is explained by the included variables. The coefficient associated with

HALE is positive and statistically significant ($\beta = +420$; $p < 0.01$), indicating that a one-year increase in healthy life expectancy leads, on average, to an increase of approximately \$420 in GDP per capita. The coefficient for DALY is negative and significant ($\beta = -0.35$; $p < 0.01$), confirming that morbidity and disability reduce productivity and increase economic costs.

The results of the analysis highlight the existence of a strong and significant relationship between public health and economic growth in the Republic of Moldova. Both the benchmarking analysis and the statistical results (Pearson correlation and linear regression) confirm that the level of population health is a key determinant of economic performance.

The health indicators analyzed reveal a significant gap between the Republic of Moldova and the European Union average. Healthy life expectancy (HALE) is considerably lower, while the burden of disease, expressed in DALYs, is significantly higher. The DALY structure, dominated by cardiovascular diseases, indicates the need for systemic preventive interventions.

The econometric analysis confirms the theoretical hypotheses regarding the link between health and the economy. The strong positive correlation between HALE and GDP per capita, as well as the negative correlation between DALY and economic performance, demonstrate that a healthier population contributes to increased productivity and economic development.

An important aspect highlighted by the analysis relates to the financing of the healthcare system. The share of healthcare spending in GDP is relatively close to the regional average, but the absolute level of resources remains low, and dependence on out-of-pocket payments by the population is high, leading to inequalities in access to medical services.

The study's findings support the integrated model of "health – human capital – productivity – economic growth." Investments in prevention, digitization, and the modernization of medical infrastructure can generate multiplier effects on the economy, contributing to an increase in working life expectancy and a reduction in disease-related costs.

Moldova's integration into the European space offers significant opportunities for modernizing the health system through the adoption of international standards and access to financial resources and expertise. Alignment with European performance indicators, including HALE and DALY, can help monitor progress and inform strategic decisions.

5. Conclusions and Policy Recommendations

This article set out to examine the extent to which public health indicators - healthy life expectancy (HALE), the burden of disease (DALY), health system expenditure, and out-of-pocket payments - exert a statistically significant effect on GDP per capita in the Republic of Moldova, and how this relationship compares with EU benchmarks. The empirical analysis, combining benchmarking across comparable European countries with a multiple linear regression model ($R^2 = 0.71$), yields several principal findings.

First, healthy life expectancy emerges as the strongest positive predictor of economic performance: a one-year increase in HALE is associated, on average, with an increase of approximately \$420 in GDP per capita ($\beta = +420$; $p < 0.01$). Second, the disease burden measured in DALYs exerts a significant negative effect on economic output ($\beta = -0.35$; $p < 0.01$), confirming that morbidity and disability translate directly into productivity losses and elevated social expenditures. Third, health system financing exerts a positive and statistically

significant effect ($\beta = +180$; $p < 0.05$), while the share of out-of-pocket payments has a marginal negative effect ($\beta = -90$; $p \approx 0.05$), indicating that household financial vulnerability constitutes a structural drag on both health outcomes and economic activity.

These results confirm the central working hypothesis of the study: inadequate public health investment and persistently elevated disease burden represent binding constraints on Moldova's economic growth trajectory. The pattern identified - health $\downarrow \rightarrow$ productivity $\downarrow \rightarrow$ economic growth $\downarrow$ - is consistent across all analytical layers of the study, from the correlation matrix to the regression model and the benchmarking tables. Moldova's HALE of 63 years lags the EU average by 7 years, while its DALY rate of approximately 27,000 per 100,000 population exceeds the EU average by 50%, with cardiovascular diseases accounting for 45–50% of the total disease burden compared to 30% in the EU. These gaps have direct and measurable economic consequences, reflected in a labor productivity index of approximately 45 against an EU baseline of 100.

This study makes three contributions to the existing literature. First, it provides one of the few quantitative analyses of the health–growth nexus calibrated specifically to Moldova's national context, using internationally comparable indicators (HALE, DALY) that are rarely integrated simultaneously in growth models for Eastern European transition economies. Second, it demonstrates the practical utility of synthetic health indicators - particularly HALE and DALY - as instruments for EU convergence monitoring, extending their application beyond the public health literature into economic policy analysis. Third, by linking empirical findings to a structured set of KPI-based policy recommendations, the article bridges the gap between econometric modeling and actionable health governance, a dimension that remains underdeveloped in the existing literature on Moldova.

The findings carry concrete implications for public policy. The most urgent priority is a structural increase in public health expenditure, from the current estimated 4.5% of GDP toward a minimum of 6%, alongside a reduction in out-of-pocket payments from 45–50% to below 25% of total health expenditure. These financing reforms are necessary conditions for reducing the inequalities in access to care that amplify the economic costs of poor health. Simultaneously, the predominance of cardiovascular diseases in Moldova's disease burden calls for a reorientation of health policy toward prevention, early screening, and lifestyle intervention, areas where current coverage (approximately 30% of the population screened) falls far short of what is needed.

To support the operationalization and monitoring of these priorities, Table 7 below presents an integrated set of public policy recommendations linked to measurable KPIs and 2030 targets. The targets proposed in this table are formulated by the authors on the basis of the empirical gaps identified in the analysis, informed by and partially aligned with strategic documents including the EC's State of Health in the EU country profile for Moldova (EC, 2023), the UNDP Human Development Report (UNDP, 2023), and OECD health system performance frameworks (OECD, 2024). Where applicable, targets reflect the minimum thresholds necessary to achieve meaningful convergence with EU averages within a realistic medium-term horizon, rather than full convergence, which would require a substantially longer timeframe.

This study is subject to several limitations that should be acknowledged. First, the regression model is based on cross-sectional comparative data for a limited set of countries, which constrains the ability to establish causal directionality and control for country-specific fixed

effects. Future research should apply panel data methods covering a longer time series for Moldova and comparable transition economies to strengthen causal inference. Second, the HALE and DALY values used for Moldova are drawn from WHO and IHME aggregate estimates, which carry their own methodological uncertainties and may not fully capture subnational variation between urban and rural populations - a dimension flagged as significant in this study but not modeled explicitly.

Table 7. Public policy recommendations linked to KPIs and 2030 targets

No.	Area of intervention	Indicator (KPI)	Current estimated value (2022–2024)	2030 Target	Expected impact
1	Prevention and noncommunicable diseases	Mortality rate from cardiovascular diseases (per 100,000)	~550	≤400	DALY reduction
		Proportion of the population screened (%)	~30%	≥70%	Increase in HALE
2	Financing and financial protection	Public health expenditure (% of GDP)	~4.5%	≥6%	Improved access
		Out-of-pocket (% of total expenditure)	45–50%	≤25%	Social equity
3	Digitization	Share of electronic medical records (%)	~40%	≥95%	System efficiency
		Telemedicine consultations (%)	<5%	≥30%	Rural access
4	Human resources	Number of doctors per 10,000 inhabitants	~30	≥40	Quality of services
		Medical staff turnover rate (%)	~10–15%	≤5%	System stability
5	Health–economy integration	Labor productivity (index, EU=100)	~45	≥65	Economic growth
		Employment rate (%)	~45%	≥60%	Human capital
6	Monitoring and indicators	HALE (years)	63	≥68	Healthy life
		DALY (per 100,000)	27,000	≤20,000	Low burden
7	European integration	EU-funded projects (no./year)	Low	≥20/year	Modernization
		Degree of legislative harmonization (%)	~60%	≥90%	EU convergence
8	Territorial equity	Access to healthcare in rural areas (%)	~60%	≥85%	Reduction of inequalities
		Rural vs. urban physician density (%)	<50%	≥75%	Regional balance

Source: Authors' elaboration based on WHO (2024); IHME (2024); OECD (2024); NBS (2024), and national policy priorities.

Third, the regression model does not account for potential endogeneity between health expenditure and GDP per capita, a well-known challenge in the health–growth literature that future work should address through instrumental variable approaches or Granger causality tests. Finally, the behavioral and institutional determinants of the high out-of-pocket payment share - including informal payments, patient cost-sharing design, and insurance coverage gaps - merit dedicated qualitative investigation to complement the quantitative picture offered here.

In sum, public health in the Republic of Moldova is simultaneously a determinant and an outcome of economic growth. The evidence presented in this article establishes that closing the health gap with the EU is not merely a social policy objective but an economic necessity. Sustained investments in prevention, health system financing reform, digitization, and territorial equity, pursued within the framework of EU integration, represent the most direct pathway toward increasing healthy life expectancy, reducing the disease burden, and unlocking Moldova's human capital potential.

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STRUCTURE OF EUROPEAN FUNDING BY SECTORS OF ECONOMIC ACTIVITY CASE STUDY - SUCEAVA COUNTY

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Abstract: Romania's economic vision must be in line with that of the European Union, aiming at integration into a global market that offers major benefits for all citizens. These benefits can only be offered in a market with common rules and economically and socially aligned regions. The present research analyzes the projects financed between 2021 and 2027, related to Suceava County, according to the updated situation of the Ministry of Investments and European Projects, the objective of the analysis being to test the research hypothesis according to which the allocation of European funds by economic sectors, at the county level, reflects their structure and share in the local economy. The results of the research refute this hypothesis, highlighting the existence of a discrepancy between the economic structure of Suceava County – where the service sector holds a majority share in terms of employment and the number of enterprises – and the structure of the allocation of European funds, characterized by a predominant orientation towards the industrial sector. This mismatch indicates that the distribution of European funds does not proportionally reproduce the sectoral configuration of the county economy. The intertwining of the expertise of the academic environment with the process of implementation and monitoring of European funds can strengthen the qualitative component of the investments made. Universities can support the targeting of European resources towards projects that foster job creation, high value-added investments, competitive goods, and services on the European market.

Keywords: european funds; economic sectors; economic indicators; the structure of the funding; economic indicators.

Classification JEL: R11, R58, H54.

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1. Introduction

A competitive business environment, creating added value and jobs, is a fundamental element in the European desire for the economic alignment of regions. The non-reimbursable European funds are thus an important tool for reducing the economic and social gap between European regions, Romania, as an EU member state, benefiting from non-reimbursable financial aid within the multiannual financial years, having the opportunity to develop the business environment, human capital and related infrastructure.

The present analysis builds its research architecture, in a first stage, through a theoretical analysis of the literature, an analysis later completed, at a practical level, by empirical research. The choice of Suceava County as a study area was determined by the upward dynamics of access to non-reimbursable European funds by the private sector, as well as by its diversified economic structure. The economic characteristics of the county are comparable to those of other counties in Romania, which gives the results obtained a potential for generalization.

The objective of the research is to respond to the need to document and interpret the impact of non-reimbursable European funds on the economic environment in Suceava County. The objective is to test the research hypothesis, according to which there is a correlation between the economic structure of Suceava County and the structure of the allocation of European funds within the county. At the same time, trends at European, national and county levels are considered, regarding indicators such as gross value added, number of active companies, number of employees, to identify investment potential and assess financial sustainability.

2. Literature Review

The synchronization of national policies with European directions is a complex process, which requires not only economic coherence, but also a strategic approach of a diplomatic nature. Access to and use of European funds are conditioned both by the allocation mechanisms established at national level and by the negotiations carried out within the multiannual financial years, where difficulties related to implementation, legislative compliance or administrative capacity may arise. In this context, the central institutions responsible for coordinating European funds, such as the Ministry of Investments and European Projects, play an essential role in articulating an institutional conduct and diplomacy oriented towards cooperation and adaptability. Silvia Timofti (2013), in "Interdisciplinary Studies", concludes "diplomacy has always found its place in society, along with the culture, values, customs of a nation, which matters a lot for a rule of law."

Bostan et al. (2022) conduct a study in which they evaluate a sample of businesses, through specific indicators, highlighting that European funds have a positive impact on economic development, but this impact is conditional. This opinion complements the literature, where several authors argue in favor of a conditional effect, determined by factors such as the efficiency of the institutional system of absorption of funds.

The functioning of the European economy requires balanced manifestation at the level of all national regions, and not only in large urban centers with a well-established economic tradition. Access to non-reimbursable funds is influenced by the degree of regional economic concentration, which leads to significant differences in absorption capacity between regions. The analysis highlights that regions with a high level of economic development concentrate a disproportionate share of European financial resources, amplifying territorial disparities. (Chele & Hapenciuc, 2025).

Strategic thinking is based on the use of comparable indicators at macroeconomic level, which are essential tools for assessing economic performance, identifying development trends and formulating sustainable economic policies. In parallel with the economic performances, the level of public debt in Romania (>55% of GDP, at the level of 2025), a level that has increased considerably in recent years, must also be considered. In "The

Wealth of Nations" (1776), Adam Smith does not support the idea of public debt as a systematic instrument of economic stimulation. On the contrary, Smith looks at public debt with caution, considering it a phenomenon that, although it may become inevitable in certain economic circumstances, tends to generate constraints on future generations.

At the same time, Nedelea (2016), in the publication "Marketing. Concepts and experiences", presents the law of trend. This psychological law expresses the fact that "we tend to do what the majority of the group we belong to does." Romania, like the states of the European community, and not only, has adopted an economic model based on budget deficit and indebtedness, because of imitating the dominant practices at European level. A modern and balanced economic model does not imply the elimination of public debt, but it implies an antithesis between economic construction and the public debt generated for its construction.

The objective of European funds, within economic cohesion policies, is to establish a balance between capital and jobs. Capital is the one that provides efficiency and competitiveness, and employees represent consumption, innovation and social balance, Gherghina (2016) specifying the role of jobs in avoiding the "loss of human capital, the migration of brains and specialists."

Institutions must play a strategic role as support organizations for the private sector, in the context of reducing administrative and informational barriers. By providing advisory, training and technical assistance services, institutions can contribute to increasing the absorption of non-reimbursable funds and strengthening the entrepreneurial ecosystem. "Development of services by public authorities (e.g. Chamber of Commerce and Industry) to help young entrepreneurs and start-ups obtain European funding" is a recommendation outlined by Chihaiia (2024), within the doctoral thesis: "Analysis of the implementation of European projects in the context of regional development".

The field of European funds is a strategic one and requires coordination and collaboration between institutions, avoiding individual ambitions or rigid hierarchies. The joint efforts of several institutions must guide this strategic approach. "The prestige of the teacher must be demystified, there is no one who knows and no one who learns: there is only a common, comradeship effort to advance a just cause" This perspective highlights that the efficiency of the economic sectors is closely linked to the ability of the institutions responsible for the implementation of EU funds to coordinate resources and support the private sector in achieving economic objectives.

3. Methodology

The report is based on a quantitative approach, carried out by collecting and processing data from the websites of the National Institute of Statistics (INS), Eurostat, as well as the Ministry of Investments and European Projects (MIPE).

The analysis consists, in a first stage, in carrying out empirical research of the GVA and GDP indicators to ascertain an economic dynamic, but also a structure of the economy by sectors of the national economy. This approach is necessary to visualize the implications of European funds in the main economic sectors, and not only for the economy. Indicators at county and national level were also analyzed, such as the number of active units, the number of employees and net investments.

The data were synthesized by sectors of economic activity and types of units benefiting from European funds, to highlight the typology and characteristics of the beneficiaries, this descriptive statistical analysis providing, in addition to a clear structure of the data, also an identification of trends.

The analysis was carried out on the entire population of units benefiting from European funds, in Suceava County, which gives the study an exhaustive character at territorial level. The submission of files for accessing European funds is conditioned by a complex set of institutional criteria, which makes it difficult to identify a group of non-beneficiary companies that are comparable to the beneficiary units. The analysis considers exclusively the units benefiting from European funds, in Suceava County, all of which are evaluated within the same territorial and institutional context.

To achieve the proposed objective, the database available on the official website of the Ministry of Investments and European Projects was queried on 10.07.2025. The projects financed from European funds in the period 2021 – 2027, related to Suceava County, were selected, according to the situation updated on May 5, 2025. The period from July 2025 to February 2026 involved an analysis of the beneficiary units, during all this time this monitoring was corroborated with the detailed analysis of the specialized literature, both approaches being intertwined throughout the drafting of the report.

4. Results and Discussion

Gross value added (GVA) – at national/European level

The analysis of the efficiency of the sectors of economic activity influenced by the absorption of European funds is closely correlated with the assessment of GVA by sectors of activity, as this indicator reflects the contribution of each sector to the formation of the gross domestic product and highlights the level of economic performance generated by the use of available resources, including European funds.

Thus, table no. 1 shows the structure of gross value added (GVA), broken down by the main economic branches, in 2023. It is worth mentioning that the latest data processed and published by the National Institute of Statistics (Tempo Online), on activities of the national economy, are those related to 2023. The data highlight significant differences between economic sectors in terms of their contribution to the formation of gross value added.

Table 1. Gross value added at national level

GROSS VALUE ADDED	Year 2023	
	million lei	%
AGRICULTURE (division 01 - division 03)	52.879,2	3,64
INDUSTRY (division 05 - division 39)	302.950,6	20,85
CONSTRUCTIONS (Division 41 - Division 43)	127.939,1	8,81
SERVICES (Division 45 - Division 99)	968.928,2	66,70
TOTAL	1.452.697,1	100%

Source: author's processing, according to data from the Tempo Online database (2025)

The services sector holds an overwhelming share, representing 968,928.2 million lei, in the total gross value added created in Romania, for 2023, which represents approx. 67%.

This percentage underlines the process of outsourcing Romania's economy, with a focus on activities specific to the services sector, such as trade, transport, communications or financial services.

According to figure no. 1, the national economy is dominated by the service sector, followed by the industry sector, while construction and agriculture contribute to a lesser extent. This structure is specific to modern, developed and developing economies, where the focus is on activities in the tertiary sector.

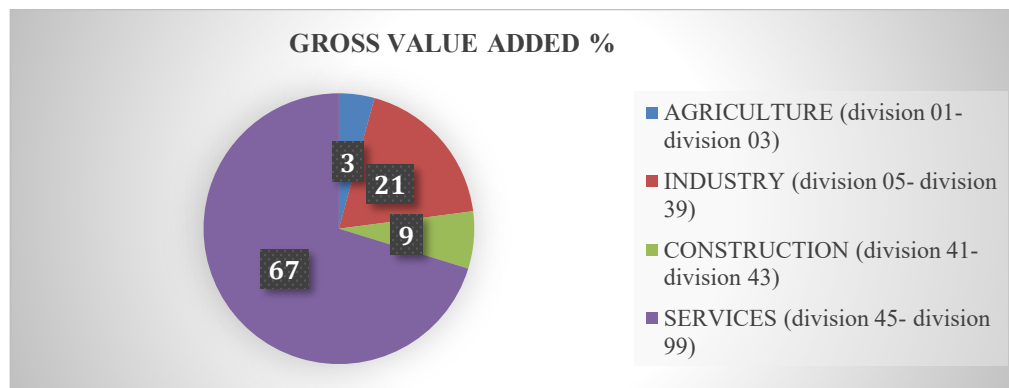


Figure 1. GVA structure, at national level, year 2023

Source: author's elaboration, according to the Tempo Online database (2025)

As economies become more developed, the share of services increases, that of industry decreases proportionally, reflecting the transition from production-based economies to those based on knowledge, technology and services. This trend reflects the process of tertiarization of the economy, implicitly of Romania, specific to post-industrial economies, but maintaining a solid industrial base is considered essential to support exports, stimulate innovation and ensure stable and well-paid jobs. Thus, a balance between economic sectors becomes essential to monitor for sustainable economic development and resilience.

Next, the Eurostat database was queried, to obtain the structure of the gross value added, for the years 2020-2024, at international level (Romania, Bulgaria, Germany, France and the EU 27 average), for the agriculture, construction and industry sectors. As for the construction sector of the Romanian economy, it is on an upward trend: from 6.5% in 2020 to a peak of 7.6% in 2023, remaining at 7.5% in 2024. These values are above the EU average of around 5%, reflecting the dynamics of infrastructure and the real estate sector.

Table 2. Gross value added and income in CONSTRUCTIONS – weight (%)

CONSTRUCTION					%
	2020	2021	2022	2023	2024
Romania	6,5	6,4	6,8	7,6	7,5
Bulgaria	4,2	3,5	3,4	3,9	3,9
Germany	4,5	4,4	4,4	4,8	4,8
France	5	5	4,9	5,1	5
European Union - 27 countries (as of 2020)	4,9	4,9	4,8	5,1	5

Source: author's processing according to Eurostat database data (2025)

Agriculture in Romania consistently registers the highest shares, significantly above the EU average, but with a downward trend, from 4.6% in 2021 to 3.3% in 2024, which indicates the process of convergence towards the European average of 2%.

Table 3. Gross value added and income in INDUSTRY

INDUSTRY					%
	2020	2021	2022	2023	2024
Romania	20	19,7	20,5	19,1	17,5
Bulgaria	17,7	17,3	21,9	18,8	18,6
Germany	20,9	20,9	21,3	22,4	20,9
France	11,3	11,1	10,8	13	12,2
European Union - 27 countries (as of 2020)	17,2	17,4	18	18,2	17

Source: author's processing according to Eurostat database data (2025)

The **GVA analysis** carried out by sectors of activity, places the data in a European context and highlights that Romania presents a structure relatively like that of the Bulgarian economy, but also of Western European countries, such as Germany and France, as follows:

- **The agriculture sector** of 2024 represents in Romania, in terms of gross value added, a percentage of 3.3%, in Bulgaria 2.1%, and the European Union average is 1.6%.
- The gross value added in **the construction sector** represents, for the Romanian economy, from 2024, the value of 7.5%. In the same year, Bulgaria accounts for 3.9%, Germany 4.8%, and the Union average stabilizes at 5%.
- Romania's **industrial sector**, as of 2024, reflects a gross value added of 17.5%, while Germany tends to 21% in the same year, the EU average being 17%.
- **The services sector** represents, for the European Union, the dominant sector, in Romania the data available in Tempo Online, for 2023, highlighting the percentage of 67% in total gross value added at national level, a percentage like that in EU countries.

The similarity of sectoral value added at European level indicates the existence of relative structural convergence and should not be interpreted as economic convergence in the absolute sense, as the levels of value added, productivity and economic capacity differ significantly between European states and regions.

Analysis of economic indicators at county and national level

According to the (available) data extracted from the Tempo Online database, of the National Institute of Statistics, Suceava County has a number of 17,281 active local units. Of these, 71.91% were active in the service sector, followed by construction (12.82%), industry (11.32%) and agriculture (3.95%). This structure confirms the predominance of the tertiary sector in the local economy, which reflects a county economy focused on trade, transport, education and other services, but with a significant presence in construction and industry.

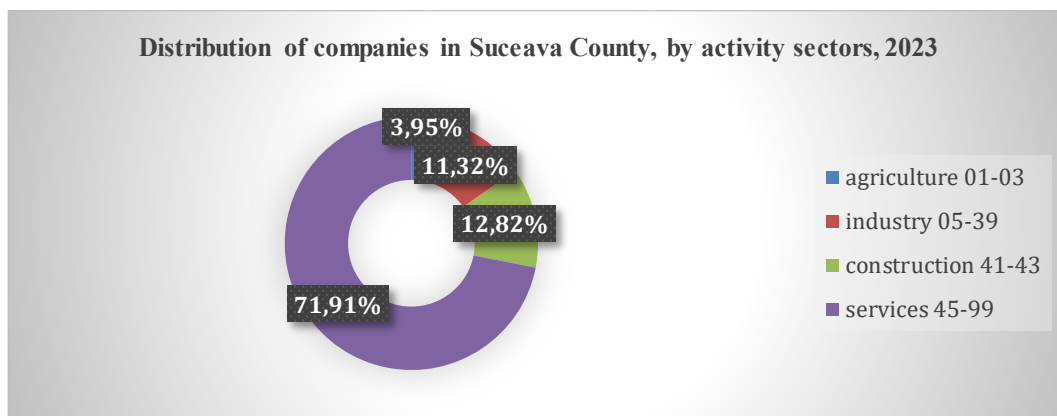


Figure 2. Grouping of companies in Suceava County by sectors of activity, 2023

Source: author's elaboration, according to the Tempo Online database

Another indicator of interest, at the level of Suceava County, is the number of employees. In 2023 compared to 2022 there is a significant global increase, thus the total number of employees increased by 6.22%, the private sector, and 4.2% per total county employees, signaling a consolidation of the local labor market (Tempo Online). Services remain the dominant economic sector, in the context in which over 67% of all employees are in services, reflecting, again, the general trend of tertiarization of the economy of Suceava County. Employees in agriculture registered the lowest share, up to 3%.

The data on national net investments lead us to the conclusion that macroeconomic trends are those of development focused on services and industry. The net investments, at national level, for 2023 (the latest data available from Tempo Online), show us that the services sector presents a percentage of approximately 60%, indicating, again, the process of economic outsourcing.

Economic evolution of the units benefiting from European funds

The 167 projects carried out, beneficiaries of non-reimbursable European funds, related to Suceava County, were divided into five categories of entities, according to figure 3.

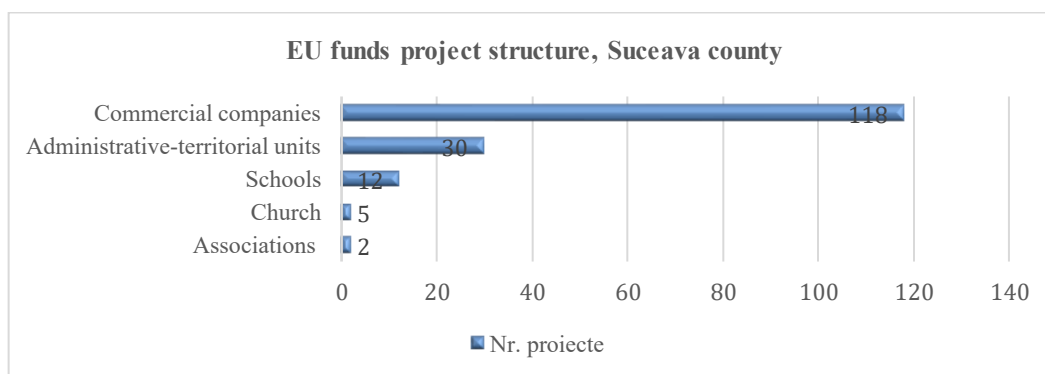


Figure 3. Structure no. EU funds projects, Bucharest County. Suceava, 2021-2027

Source: author's elaboration, according to the <https://mfe.gov.ro/> database

All the data presented above were collected by querying the database of the Ministry of Investments and European Projects, which provided statistics of projects financed from

European funds, for Suceava County. The total value of the projects was in the amount of 2,253,502,706 lei.

From the perspective of accessing European funds, for Suceava County, companies hold the highest value of projects, more precisely 1,667,877,936 lei (74%), also benefiting from the largest non-reimbursable budget and own contribution, which suggests an active involvement in attracting non-reimbursable funds.

Structure of European funding by sectors of economic activity

Out of the total of 167 projects related to Suceava County, the 118 projects belonging to the companies were subjected to analysis. The business environment represents 74% of the total value of projects and is a key element of sustainable development. As such, monitoring it is of interest.

Table 4 provides a detailed picture of the financing structure and allocation of European funds for the 118 projects related to companies, on the 4 sectors of the national economy.

Table 4. Distribution of projects of financed companies by sectors of economic activity, in Suceava County

SECTORS OF ACTIVITY	TOTAL EU BUDGET	TOTAL STATE BUDGET	TOTAL NON-REFUNDABLE	TOTAL OWN CONTRIBUTION BUDGET	TOTAL ELIGIBLE BUDGET	TOTAL INELIGIBLE BUDGET	TOTAL PROJECT VALUE	%
Agriculture 01-03	1254761	221428	1476189	196086	1672275	199313	1871588	0,12
Industry 05-39	1009533462	154726227	116459689	26775240	1191034929	309411696	1500446625	96,32
Construction 41-43	5323799	939494	6263293	1276507	7539800	1357280	8897080	0,57
Services 45-99	29697238	5240689	34937927	5613997	40551924	6036017	46587941	2,99
Total county. Suceava	1045809260	161127838	159137098	33861830	1240798928	317004306	1557803234	100

Source: author's elaboration, according to the <https://mfe.gov.ro/> database

Financing structure (absolute values and weights):

- a. The total value of the projects = 1.56 billion lei, with the structure presented in figure 4.

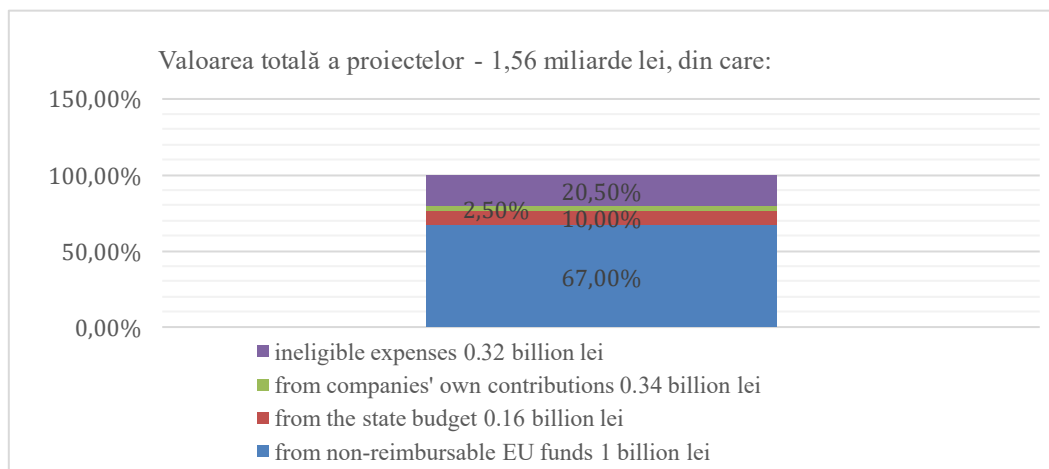


Figure 4. Financing structure, by origin

Source: author's elaboration, according to the <https://mfe.gov.ro/> database

The companies surveyed indicate a major absorption of European funds, which managed to attract considerable non-reimbursable European funding for investments (67%), in parallel with a national (10%) and own (2%) contribution.

b. Distribution of projects by economic branches, within companies (fig. 5)

The distribution on the four economic branches: agriculture (division 01-03), industry (05-39), construction (41-43) and services (45-99) and the analysis of all projects is presented as follows:

- **Industry (Division 05-39):** It owns most of the budget: 96.32% of the total value of the projects, i.e. over 1.5 billion lei. In fact, this economic sector benefited from the largest volume of European funds (96.5%) and the state budget (96%). This reveals a strategic prioritization of reindustrialization as well as high impact investments.
- **Services (Division 45-99):** The Services economic sector attracts only 2.99% of the total projects, which highlights an underfunding of the tertiary economy, despite the 70% share held by this sector in GVA (Figure 2.1).
- **Construction (division 41-43):** This sector holds a modest share (0.57%), but it must be essential for the future, for the creation of infrastructure.
- **Agriculture (Division 01-03):** It represents the economic sector with the lowest share, of 0.12% of the total value of projects. The lack of absorption of non-reimbursable European funds in this sector can be caused by the reduced administrative capacity. The sector may present companies without experience and maturity in approaching European funds.

5. Conclusions

The research architecture aimed to test the research hypothesis according to which the allocation of European funds by economic sectors, at county level, reflects their structure and share in the local economy.

Because Romania, Bulgaria, France, Germany and other European countries register shares relatively like that of gross value added by economic sectors, this aspect reflects a structural convergence within the European Union. This convergence reflects the outcome of European economic integration, the functioning of the single market and the harmonization of economic and regional policies.

The analyzed data, at county, national and European level, regarding the number of employees, the number of local companies, net investments, gross value added by economic sectors, converge towards the conclusion that the economic sector of services represents the substantial component of the economy, at all levels, from county, national and up to European level.

Although the industry has a relatively low share in the total number of active companies in Suceava County (13%), it registers the highest participation rate in European funding (approx. 70% in total projects and 90% at the level of commercial companies), confirming the previous observations on the concentration of projects with investment impact in this sector. Even if services are dominant in Suceava's economic structure (GVA 70% - in 2022, number of active companies 72% - in 2023, number of county employees 67% - in 2023), the data reflects that the industrial sector is best represented in European funding calls. The

concentration of funds in the industrial sector suggests a regional inclination towards the modernization of production, but also the attraction of major investments.

The results of the analysis indicate that Hypothesis according to which the allocation of European funds by economic sectors, at the level of Suceava County, reflects their structure and share in the local economy, is refuted.

Relevant, in accessing European funds, for Suceava County, is the fact that the business environment holds the highest value of projects, more precisely 1,667,877,936 lei (74% in total project value). A strategic approach, however, also involves increasing institutional support for non-profit and educational entities. Also, there is a need for a consolidated economic framework that would further support the development of the business environment, the latter being a creator of budget revenues.

As European funds are a fundamental strategic resource, the understanding and responsible management of which are essential for the efficient functioning and sustainable development of the business environment, it is recommended that a Territorial Profile Monitoring. Thus, each administrative-territorial unit (TAU) must be digitized and monitored, the reference point being the business environment of that locality.

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EQUITY CROWDFUNDING IN THE CONTEXT OF INCLUSIVE ECONOMIC GROWTH

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Abstract: *Equity crowdfunding is a modern tool for raising capital which increases access to finance for small and medium-sized enterprises while making investment opportunities more accessible. This paper analyses the role of equity crowdfunding in the context of inclusive economic growth, examining its theoretical basis, the relevant institutions and the socio-economic implications. The methodology is based on comparative institutional analysis and the synthesis of secondary data. The results demonstrate that, when accompanied by effective regulation and digital transparency, this mechanism can contribute to financial inclusion, regional development, and support for innovative SMEs. However, risks of information asymmetry and regulatory fragmentation have also been identified. It is concluded that there is a need to harmonise the regulatory framework and develop digital financial literacy.*

Keywords: *Equity Crowdfunding; Inclusive economic growth; Financial inclusion; SME financing; Digital platforms.*

Classification JEL: G23, L26, O16.

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1. Introduction

In an era of global economic transformation, equity crowdfunding has emerged as an innovative mechanism that can radically change the way capital is raised and stimulate inclusive economic growth. As Ahlers et al. (2015) have noted, this instrument enables small and medium-sized enterprises (SMEs) to bypass the rigid barriers of traditional financing, opening up investment opportunities for a wide range of participants and thereby democratizing the capital market. Current scientific knowledge emphasizes that traditional sources of financing, such as bank lending and venture capital, are often characterized by high selectivity and limited accessibility, particularly in developing economies (Demirgüç-Kunt et al., 2022). This creates a structural financial gap that hampers entrepreneurial activity and exacerbates social inequality, contradicting the fundamental principle of inclusive growth: economic development should be geared towards equal opportunities and the involvement of all sections of society (Stieglitz, 2012).

This study aims to assess the potential of equity crowdfunding as a catalyst for inclusive economic growth. Despite the dynamic growth of platforms such as Crowdcube and Seedrs, questions remain regarding the risks of information asymmetry and regulatory fragmentation, as well as the extent to which they contribute to social inclusion (Schwienbacher, 2019). This study aims to conduct a comprehensive theoretical analysis of the instrument to reveal its role in expanding access to capital and fostering sustainable economic models. To achieve this, the following objectives are addressed: 1) examining the theoretical foundations of inclusive economic growth and financial inclusion; 2) examining the economic nature and operating mechanisms of equity crowdfunding; 3) assessing its potential to support SMEs; and 4) identifying institutional constraints, risks, and regulatory aspects.

The research hypothesis posits that effective regulation and digital transparency have the potential to significantly enhance the financial inclusion of equity crowdfunding, promote regional development, and foster innovation in the SME sector. However, the effectiveness of these factors depends directly on the harmonization of the regulatory framework and the improvement of financial literacy among market participants.

The methodological approach is based on comparative institutional analysis and synthesizing secondary data from academic literature, reports by international organizations such as the OECD and the World Bank, and regulatory documents. Qualitative methods are employed to ensure depth of interpretation without the need for empirical experiments. This study's significance lies in its contribution to management and economic policy theory: in the context of digitalization, equity crowdfunding can be a vital component of sustainable development strategies, helping small businesses overcome growth barriers. Preliminary analysis suggests that this mechanism lowers barriers to entry into the capital market and stimulates the formation of an investment culture. However, a careful balance must be struck between innovation and investor protection.

2. Literature Review

Contemporary economic literature views inclusive economic growth as development that not only increases output, but also expands economic opportunities for various social groups. Unlike traditional models, which focus primarily on gross domestic product dynamics, this approach emphasizes distributing the benefits of economic growth and ensuring equal access to resources and opportunities (Stiglitz, 2012; World Bank, 2013).

As Stiglitz (2012) notes, economic growth accompanied by high income and capital concentration can exacerbate socioeconomic inequality and undermine the long-term sustainability of economic development. In this context, inclusiveness is considered a social objective and a means of enhancing the efficiency of economic systems.

One of the key mechanisms for achieving inclusive growth is financial inclusion, ensuring that households and businesses have access to basic financial services. According to World Bank research (Demirgüç-Kunt et al., 2022), expanding access to financial instruments contributes to entrepreneurship development, increased economic activity, and reduced inequality.

Data from the Global Findex Database (2025) show that the proportion of the adult population holding a financial account has risen to 79%, while around 1.3 billion people remain formally excluded from the financial system to a greater or lesser extent. Despite this positive trend, access to finance for small and medium-sized enterprises (SMEs) remains limited due to banks' requirements regarding collateral and credit history. This creates the so-called 'financial gap' (OECD, 2020). In this context, alternative forms of financing based on digital technologies and platform mechanisms are becoming increasingly important.

Crowdfunding is a mechanism for raising capital via digital platforms, enabling funds from a large number of investors to be pooled to finance entrepreneurial projects. One of the earliest theoretical explanations of how crowdfunding works comes from a group of authors (Belleflamme et al., 2014), who demonstrate that digital platforms can significantly reduce transaction costs and expand the pool of potential investors.

Among the various forms of crowdfunding, equity crowdfunding plays a special role, involving the provision of equity stakes in a company to investors. A study by Ahlers et al. (2015) views this mechanism as a hybrid form of financing, combining elements of venture capital investment and collective investor participation. The authors demonstrate that the success of crowdfunding campaigns is largely determined by informational signals such as project transparency, ownership structure and the level of the founders' equity stake in the company.

Further research confirms that alternative financial instruments can stimulate entrepreneurial development and support the launch of new companies, particularly in the early stages of business development (Bruton et al., 2015). This is particularly relevant for SMEs, which often face restrictions on access to bank lending and venture capital.

From an institutional perspective, the development of crowdfunding is linked to a broader transformation of financial markets in the context of digitalization. Zetsche et al. (2018) note that digital financial technologies create new forms of intermediation and an alternative infrastructure for capital allocation, contributing to the expansion of investment opportunities for private investors.

Despite the significant potential of crowdfunding, the academic literature also highlights the risks and institutional constraints of this mechanism. One of the key problems is the information asymmetry between entrepreneurs and investors, which can lead to inefficient capital allocation and increased investment risk (Schwienbacher, 2019).

Empirical studies confirm that the structure of crowdfunding campaigns significantly impacts their likelihood of success. In particular, Cumming et al.'s (2020) analysis shows that 'all-or-nothing' funding models are more effective than 'keep-it-all' models because they reduce investor risk and increase project trustworthiness.

Analytical reports by the OECD (2020; 2022; 2025) also emphasize the sensitivity of alternative financial instruments to macroeconomic conditions and changes in financial regulation. Amid inflationary pressures and rising interest rates, the alternative finance market remains volatile, underscoring the importance of an effective institutional environment.

At the same time, the global crowdfunding market is demonstrating steady growth. According to estimates by international analytical agencies, its volume reached approximately \$1.83 billion in 2025 and is forecast to increase to \$5.91 billion by 2034, at an average annual growth rate of around 13.7% (Market Data Forecast, 2025); Research and Markets, 2025). The equity crowdfunding segment is also showing positive growth, determining its growing role in the system of alternative sources of financing (Market Reports World, 2026; Spherical Insights, 2025).

An analysis of the academic literature shows that crowdfunding has significant potential to expand financial inclusion and support entrepreneurship. However, its effectiveness depends on various factors, including the institutional environment, the level of regulation, and the development of digital infrastructure.

Despite a significant body of research in the fields of financial inclusion and alternative financing, the relationship between equity crowdfunding and inclusive economic growth remains understudied. This study aims to address this gap in the research literature by taking an integrated approach that considers institutional, financial, and socio-economic factors in the analysis of digital capital mobilization mechanisms.

3. Methodology

The study's methodological framework is based on an analytical and theoretical approach combining principles from institutional economics and management. This enables equity crowdfunding to be considered both an institutional mechanism for raising capital and a management tool that increases small and medium-sized enterprises' access to financial resources.

The research methodology is determined by the study's objectives. As the primary objective of this article is to provide a theoretical understanding of the institutional mechanisms that underlie crowdfunding platforms' operation, the focus is on a conceptual analysis of their role in ensuring financial inclusion and stimulating inclusive economic growth rather than on statistical hypothesis testing (Zetzsche et al., 2018).

The research information base was formed through a systematic analysis of secondary sources. Data sources include scientific publications from international academic journals and analytical reports from international organizations such as the World Bank and OECD, as well as regulatory documents governing alternative forms of financing. A literature search was conducted in the Scopus and Google Scholar databases using the keywords 'equity crowdfunding', 'inclusive economic growth', 'financial inclusion' and 'SME financing'.

Sources were selected based on scientific significance, relevance, and topicality. The main focus was on publications released after 2012 due to the active development of digital financial technologies during this period. Over 50 scientific and analytical sources were reviewed as a result of the analysis, and the most significant of these are included in the study's bibliography. To keep the analysis up to date, data from the Global Findex Database 2025 and the OECD *Financing SMEs and Entrepreneurs Scoreboard 2025* were also used.

The analytical part of the study is based on a combination of comparative institutional analysis and conceptual synthesis. The comparative analysis enabled the comparison of traditional and alternative financing mechanisms and the identification of the specific institutional conditions under which they operate in various economic systems (OECD, 2020; 2022; 2025, 9, 10, 16). Meanwhile, the conceptual synthesis integrated theoretical propositions on inclusive economic growth (Stieglitz, 2012; World Bank, 2013) with empirical data on the development of financial inclusion and digital financial instruments (Demirgüç-Kunt et al., 2022; Global Findex, 2025).

It should be noted that one limitation of the study is its reliance on secondary sources, with no original empirical data. Nevertheless, this approach allows for a broad analytical scope and enables the formation of a theoretically grounded understanding of the role of equity crowdfunding in the modern financial ecosystem.

The following section uses the presented methodological framework to examine the research findings. This enables us to refine the theoretical conclusions and identify the institutional and managerial aspects of equity crowdfunding in the context of inclusive economic growth.

4. Results and Discussion

The findings of this study, based on a comparative institutional analysis and a synthesis of secondary data, confirm the significant potential of equity crowdfunding as a tool for expanding financial inclusion and supporting inclusive economic growth. The analysis shows that this

mechanism can lower barriers to accessing capital for SMEs while fostering new forms of interaction between entrepreneurs and investors in the digital economy. Table 1 presents the differences between traditional and alternative forms of financing for clarity.

Table 1. A comparative analysis of traditional and alternative financing in the context of inclusive growth

Criterion	Traditional financing	Alternative financing (including equity crowdfunding)
Main source of capital	Banks, venture funds, institutional investors	Private investors through digital platforms
Minimum participation threshold	High	Relatively low
Requirements for collateral	Strict (collateral, credit history)	More flexible, based on project potential
Accessibility for SMEs	Limited	Higher
Investor involvement	Indirect	Direct, through participation in capital
Impact on financial inclusion	Limited	Promotes broader participation

Source: compiled by the author based on OECD (2020; 2022; 2025).

The data presented indicate that, in addition to diversifying sources of funding, equity crowdfunding helps to create a broader investor base comprising private investors making relatively small investments. These findings are consistent with those of Bruton et al. (2015), who argue that alternative financial instruments can stimulate entrepreneurial activity and support the development of SMEs, particularly in conditions of limited access to bank lending.

However, the analysis also identifies several limitations to this mechanism. Research shows that a significant proportion of crowdfunding campaigns fail to meet their targets, while investors face the risk of losing their investment and the low liquidity of shares (Cumming et al., 2020). Furthermore, the participation of unqualified investors exacerbates the problem of information asymmetry, necessitating effective regulatory mechanisms (Schwienbacher, 2019).

The key factors influencing the impact of equity crowdfunding on inclusive economic growth are presented in Table 2.

Table 2. Factors Influencing the Impact of Equity Crowdfunding on Inclusive Economic Growth

Group of factors	Positive influence	Limitations and risks
Financial	Expansion of SMEs' access to capital; diversification of financing sources	Risk of investment loss; low liquidity of shares
Social	Democratisation of investment; formation of investment culture	Insufficient level of financial literacy
Institutional	Development of alternative financial infrastructure	Insufficient regulatory certainty
Digital	Reduction of transaction costs; expansion of investor geography	Dependence on digital platforms

Source: compiled by the author based on Ahlers et al. (2015) Cumming et al. (2020).

Overall, the findings of this study are consistent with the conclusions of Belleflamme et al. (2014), who emphasized the role of digital platforms in reducing transaction costs and increasing access to capital. At the same time, the findings corroborate Stiglitz's (2012) assertion that more inclusive economic mechanisms are needed to reduce structural inequality in access to financial resources.

From a practical perspective, the study's findings have significant implications for management and institutions. For entrepreneurs, the key to successful crowdfunding campaigns lies in transparent information disclosure and building trust among investors. For government regulators, a key area of focus should be the development of a regulatory framework that balances supporting innovative financial instruments with protecting investors.

Thus, the findings confirm the hypothesis of the study that equity crowdfunding can serve as an effective tool for expanding financial inclusion and supporting inclusive economic growth. However, its long-term effectiveness depends on the quality of the institutional environment, the level of digital transparency and the development of regulatory mechanisms.

5. Conclusions

The study confirms that equity crowdfunding is a significant tool for promoting inclusive economic growth by enhancing financial inclusion and creating additional opportunities for small and medium-sized enterprises to develop. The analysis revealed that this mechanism lowers barriers to accessing capital for entrepreneurs and investors, stimulates innovation, and supports regional economic development (OECD, 2025; Global Findex, 2025). However, the effectiveness of equity crowdfunding depends on the extent of institutional and regulatory harmonization required to minimize the risks of information asymmetry and protect investors (Schwienbacher, 2019; Cumming et al., 2020).

From a theoretical perspective, the study's findings contribute to institutional economic theory by integrating the concept of economic equality of opportunity (Stieglitz, 2012) with modern digital financial models and platform-based capital mobilization mechanisms (Zetzsche et al., 2018). Thus, equity crowdfunding is not only viewed as an alternative source of financing, but also as an element in the transformation of the financial ecosystem in the context of the digitalization of the economy.

The practical significance of the study lies in formulating recommendations for managerial and regulatory practice. For the management of crowdfunding platforms and entrepreneurial projects, it is particularly important to increase the transparency of investment campaigns, improve disclosure mechanisms and strengthen investor confidence. In terms of public policy, it is crucial to further harmonize the regulatory framework and establish uniform regulatory standards, similar to the approaches implemented in the European Union, where the volume of funds raised through crowdfunding platforms exceeded €1 billion in 2023.

Based on the analysis conducted, particular attention should be paid to developing financial literacy programmes for investors and entrepreneurs, and to implementing technological solutions, including digital registers and platform-based mechanisms for secondary share trading, to enhance investment liquidity.

This study is primarily theoretical and analytical in nature, determining the direction of future research. Promising avenues for future work include empirical verification of the

proposed conceptual model and a comparative analysis of national models for the regulation and operation of equity crowdfunding in various institutional environments.

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PUBLIC POLICIES FOR STIMULATING PRIVATE INITIATIVE AND THE PERCEPTION OF ENTREPRENEURSHIP AMONG YOUNG PEOPLE IN ROMANIA

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Abstract: *The study aims to analyse the impact of public policies aimed at stimulating entrepreneurship among young people, taking into account the Sustainable Development Goals. Three objectives are pursued: (1) correlating the content of Romanian policies on stimulating entrepreneurship among young people with statistical realities; (2) identifying young people's perceptions of entrepreneurship; (3) identifying young people's perspectives on building an entrepreneurial professional life. The methodological approach includes, in the first phase, the analysis of the content of policies on stimulating entrepreneurship and their correlation with the impact produced, respectively the statistical evolution of entrepreneurs among the young population. The second phase presents the results of empirical research based on a sociological survey (using a questionnaire) that captures young people's views on entrepreneurship and their prospects for starting a business. The reference population consists of young people in Romania.*

Keywords: *Young people, entrepreneurship, career prospects, public policies, sustainable development.*

Classification JEL: D04, D09, J24, Z18.

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1. Introduction¹

Considering the entrepreneurial environment as one of the essential drivers of socio-economic development and innovation (Niţu & Feder, 2012), and as being subject to socio-economic and political variations, the present research aims to analyse the entrepreneurial potential of the young population and to correlate it with the public policy objectives of stimulating entrepreneurship. Based on a sociological approach, the first part of the study analyses strategies and public policies in the field of private initiative and the stage of entrepreneurship development in Romania, while the second part presents the results of an empirical study conducted among students, in order to describe their perspectives on entrepreneurship.

The premise of the study is that the outcomes of any strategy aimed at increasing resilience, as well as sustainable development, depend not only on the manner of implementation but also on the opinions and choices made by the population. The latter are, at the same time, both the result of how public policies are implemented and of the collective mindset shaped over time. In the case of young people, future options and behaviours are influenced by a complex set of factors: personal aspirations, opportunities provided by society, prevailing

¹ This article represents an intermediate stage of the research undertaken to describe the professional perspectives of young people. This study presents a specific segment of the research, namely that concerning the perception of entrepreneurship. The sample predominantly covers the eastern half of Romania. The research will continue with further field data collection, aiming to cover all regions and to explore additional facets of employment and entrepreneurship

social trends and movements, public policy actions (strategies, programmes, projects), and, above all, by mindset and trust in society.

From a demographic perspective, in Romania, the resident population aged 19–34 years amounted to 3,296,008 persons as of 1 July 2024. According to the Institutul Național de Statistică [National Institute of Statistics], the total student population (including all age groups) was 568,608 persons (253,532 male and 315,076 female), with the female population accounting for 55.4% of the total number of students. Of the total number of students, 502,950 were aged between 19 and 34 years. The share of students within the population aged 19–34 (3,296,008) is 15.25%. The remaining students (65,658 persons) are aged 35 and over, representing 11.54% of the total student population (out of 568,608).

2. Literature Review

Following the key concepts of the present study, namely young people, entrepreneurship, and public policies, we will present the different facets of private initiative as reflected in the specialised literature. Five major dimensions emerge from the literature, namely: young people and their professional aspirations; the presence of interest in entrepreneurship among students; entrepreneurship as an object of the state–citizen relationship, materialised in public policy; the connection between entrepreneurship and innovation; and perceptions of the entrepreneurial environment (mindset)

The human resource currently engaged in professional activities encompasses several generations: Baby Boomers, X, Y, and Z. Young people currently enrolled in university programmes predominantly belong to two generations: Generation Z (individuals born between 1997 and 2012, currently aged between 13 and 28) and Generation Y (individuals born between 1981 and 1996, currently aged between 29 and 44). S. Raiu describes Generation Z (iGeneration) as having an affinity for social interaction and learning via the internet, challenging authority, demanding independence, and leaving jobs that do not bring them fulfilment, while being responsible and committed to long-term goals. Generation Y (Millennials) is portrayed as individualistic, working smartly, preferring intrinsic work values (autonomy, identity, challenging jobs, and self-expression), seeking flexible career paths, communicating well with supervisors, and performing best in teams (2021).

When planning their professional trajectory, most secondary school students aim for employment and consider that professional success is ensured not only by competences but also by the sphere of personal relationships (relatives, acquaintances), a belief present as early as secondary education (Mihail, 2014). Subsequent studies highlight the factors that determine interest in starting a business, namely the desire to bring about change in the world, the aspiration to improve one's economic standard (the accumulation of money/wealth), earning a livelihood (as a constraint generated by limited job opportunities), and continuing family tradition (Szabó et al., 2024).

Analysing entrepreneurial spirit (viewed as a guarantee of success), Dumitrașciuc identifies five descriptive indicators derived from the specialised literature: passion, optimism, continuous improvement, the assumption of calculated risks, and the achievement of set objectives (2020). Based on this research, he constructs a “model of entrepreneurial spirit”, this trait being the one that drives young people to become entrepreneurs and to change the world (Dumitrașciuc, 2020).

Knowledge of the various facets of entrepreneurship among young people enables public authorities to design programmes that support their initiatives. However, a multitude of factors mean that the scale of entrepreneurship among young people remains relatively moderate. It is widely acknowledged that entrepreneurship, as a phenomenon, has the capacity to generate significant change, and that the individual who starts a business is one who assumes risks and develops strategic plans. In 2016, against the backdrop of high unemployment in Europe, it was considered that entrepreneurs must have the courage to cope with a chaotic environment and various obstacles, rely on a social network, and engage in a continuous learning process (Kobza & Mutlucan, 2016).

The development of an entrepreneurial mindset among students is encouraged by student associations, which provide opportunities for personal development and the acquisition of competences, thereby responding to their motivation to change the world. Therefore, entrepreneurship should be fostered at all stages of life, as it has an impact across multiple domains, such as the economy, employment, technology, and society (Kobza & Mutlucan, 2016).

A study on the state–citizen relationship highlights the ways in which governance results both from formal regulation carried out by the state and from the synergies between formal and informal actors, from top-down directives and bottom-up attitudes, as well as from processes of development aimed at adapting to a general context that is not always attentive to the needs of certain segments of society (such as new entrants) (Polese et al., 2022). It is shown that, in cases of low trust in the state, citizens tend to prioritise informal relationships, some at the limits of legality, being motivated by the desire to increase their well-being (informality thus becoming an indicator of distrust in the state), with citizens perceiving the state as inefficient or weak. The importance of informal networks has been demonstrated both through the exploration of the behaviours and attitudes of groups of Romanian emigrants settled in Spain and of ethnic entrepreneurs (originating from other countries) in Croatia. (Polese et al., 2022).

Romanian studies point out that young people, compared to other age groups, are perceived as having the ability to be innovative, to find new ways of doing things, and to become “agents of change.” The young population is both a valuable resource for society and a vulnerable group, and society as a whole has viewed them rather sceptically, as a group that generates problems and conflicts, while recently ignoring their beneficial role (Ceobanu et al., 2020). However, they can generate business and play an important role in professional development through creativity, which is associated with the ability to solve problems and overcome obstacles - including transforming these challenges into business opportunities - skills that have been leveraged in the context of national or international trade fairs, crowdfunding campaigns (though less so in accelerators/incubators, festivals, conferences, workshops, or seminars).

They have business ideas outlined and the willingness to implement them, but they lack resources. Other perceived obstacles included insufficient tax incentives for young people, legislation that does not encourage youth entrepreneurship, poor education in the field, a lack of opportunities for creative young people just starting out, a lack of policies or programs aimed at young people, job instability and the lack of steady income generated by the business, and the feeling that they are not prepared to take risks, etc. Government programs and policies for startups would have the greatest impact on the development of

youth entrepreneurship, as well as workshops, mentoring programs, training sessions, and incubators or hubs (Ceobanu et al., 2020).

According to Niţu & Feder, entrepreneurship (a driver of innovation) is the result of individuals willing to take calculated risks, develop economic activities by capitalizing on opportunities, and generate added value. The concept is addressed at the microeconomic level (as a process linking value creation with entrepreneurs' attitudes and skills, and with events related to the creation and exploitation of opportunities) and at the macroeconomic level (the national framework, the business environment context).

An analysis of the conceptual model of the entrepreneurial process in Romania, the entrepreneurial framework, and the effects of innovation on entrepreneurship leads to the fundamental ideas of a research model for the entrepreneurial process (based on the 2008 Global Entrepreneurship Monitor Model, subsequently revised), grounded in three main elements: the general conditions of the national framework (which include: institutions, infrastructure, macroeconomic stability, health, and primary education), the conditions of the entrepreneurial framework-with two sub-branches: increasing efficiency (higher education and continuing education, product market efficiency, labour market efficiency, and financial market sophistication) and the sophistication of innovation (business sophistication and innovation), and the third element is called entrepreneurship (comprising entrepreneurial perceptions and attitudes and actual entrepreneurial activity) (2012).

Entrepreneurial investment, which is essential for a functioning economy, relies on an entrepreneurial and innovative culture-both of which are underdeveloped in Romania - with the public citing at least two barriers: a business environment perceived as risky and excessive bureaucracy (Institutul European..., 2025). The social environment has a major impact on young people's entrepreneurial decisions, with entrepreneurial networks playing an important role, and the fear of failure being much more pronounced in Romania compared to other countries (Szabó et al.).

3. Methodology

Drawing on international policies, the research question is: How do the Sustainable Development Goals and resilience-related issues connect with the career aspirations and future career projections of young people in higher education (students) with regard to entrepreneurship? To provide an answer, the research aims to map the content of public policies on entrepreneurship and identify young people's willingness to start businesses, as well as the factors that contribute to or hinder entrepreneurial action, so that we can estimate the potential impact of public policies. The objectives are: (1) to correlate the content of Romanian policies on stimulating entrepreneurship among young people with statistical realities; (2) to identify young people's perceptions of entrepreneurship; (3) to identify young people's perspectives on building an entrepreneurial career.

The study's hypothesis is that all objectives established through approaches focused on resilience, sustainability, and sustainable development are directly and strongly dependent on the quality of human resources and the decisions they make.

This research is exploratory in nature. The method used is a sociological survey conducted via a questionnaire. The questionnaire was designed in digital format and administered by

sharing a link. The target population consists of young people in Romania who are currently enrolled in educational programs; they are students.

The methodological approach includes, in the first phase, an analysis of the content of policies aimed at stimulating entrepreneurship and their correlation with the resulting impact, specifically the statistical trends regarding entrepreneurs among the young population (focusing on two age groups: under 29 and 30–39). In the second phase, the results of the empirical research based on the sociological survey (using a questionnaire) are presented, which captures young people's perceptions of entrepreneurship and their prospects for starting a business. The target population consists of young people in Romania.

4. Results and Discussion

The results of the analysis of public policy documents provide answers to questions such as: What do Romanian public policies say? How do they frame entrepreneurship and what do they envisage for young people? The content of six public policy documents currently in force in Romania has been analysed. What follows is a presentation of these in relation to items that are significant for the youth population in connection with entrepreneurship.

The National Strategy for Sustainable Development 2030, as a document implementing in Romania the 2030 Agenda for Sustainable Development developed by the United Nations. The principle applied is “no one is to be left behind”. It is worth noting the target set for 2030 regarding “quality education – a substantial increase in the number of young people and adults who possess relevant skills, including vocational skills, to facilitate employment, the creation of decent jobs and entrepreneurship”, which outlines the directions of future approaches concerning young people engaged in entrepreneurial activity. With regard to entrepreneurship, it is acknowledged that the measurement of the economy does not take into account the “potential of the citizen” and that action centred on “innovation, optimism and the resilience of citizens” is necessary in order to develop a culture of entrepreneurship as the foundation for achieving aspirations and material security. Within the Strategy, the existence of a legal framework that stimulates entrepreneurship among students is emphasised (Ordin nr. 3262/2017, which will be analysed in this paper) in order to promote an entrepreneurial culture; the target for 2030 aims to support start-ups, creativity and innovation, and the growth of micro, small and medium-sized enterprises. In the chapter on reducing inequalities, it is acknowledged that encouraging entrepreneurship contributes to the development of productive economic activities in rural areas; however, the targets for 2030 are not focused on young entrepreneurs, but rather concern fiscal, wage and social protection policies, the provision of support to non-governmental organisations active in the field of human rights, and the monitoring of sustainable development indicators in order to converge with the European average.

Planul Național de Redresare și Reziliență (PNRR) [The National Recovery and Resilience Plan (NRRP)], designed to ensure an optimal balance between the priorities of the European Union and Romania's development needs in the context of recovery following the COVID-19 crisis (...) has as its general objective the development of programmes and projects that support resilience, preparedness for dealing with crises, adaptation, as well as the enhancement of Romania's development potential, with reforms and investments being encouraged (through funding from the Recovery and Resilience Facility). Part VI – Policies for the New Generation. Component 15: Education is particularly noteworthy; however, it

may be observed that the emphasis is placed on objective indicators (number of schools, number of trained teaching staff), rather than on subjective indicators concerning impact measurement, the encouragement of initiative, and the creative and proactive approach to systemic challenges, etc.

The document also includes Pillar III – Smart, Sustainable and Inclusive Growth, specifying that reforms and investments target growth potential and are intended, among other things, to support entrepreneurship and the social economy, in order to reduce the effects of the COVID-19 pandemic. Objective 1.3 – Gender Equality and Equal Opportunities aims to increase women’s participation in the labour market, supporting the reduction of gender pay gaps and facilitating career progression, including through the assumption of entrepreneurial or managerial roles. A criticism that may be levelled at this NRRP is that it does not mention concrete actions aimed at stimulating entrepreneurship among young people or at developing an entrepreneurial culture.

The document that explicitly targets young people is the *National Youth Strategy 2024–2027*. Under the general objective OG3, *Increasing youth employability and supporting entrepreneurship*, two specific objectives of relevance to our analysis are identified, namely: OS.3.1 – *Reducing poverty among young people, combating all forms of discrimination, and facilitating and ensuring social inclusion and cohesion*, and OS.3.2 – *Increasing the employment rate among young people and supporting work–life balance*. The emphasis is placed on employment (youth hiring). No specific objective is defined for stimulating youth entrepreneurship; however, it may be inferred that OS.3.2 addresses the current issue of the “lack of entrepreneurial spirit among young people”.

The Strategy refers to two programmes aimed at young people: the “*StudentInvest*” Programme, which seeks to support individuals aged between 18 and under 31 who are enrolled in higher education institutions that are either provisionally authorised or accredited. The programme places emphasis on increasing access to higher education, reducing university dropout rates, and lowering unemployment among young graduates. The “*FamilyStart*” Programme aims to support individuals aged between 18 and under 45 who are establishing a family or are in the process of forming one, by providing loans and state-funded financial support to cover specific needs. Both programmes have a socio-educational character, aiming to increase access to higher education, reduce university dropout rates, and decrease unemployment among young graduates, among other objectives. The expected outcomes of the *National Youth Strategy* include increasing employability rates and fostering entrepreneurship through measures involving information provision, training, counselling, and career guidance. These measures are intended both to facilitate the transition from the education system to the labour market and to develop an entrepreneurial culture among young people, as well as to promote entrepreneurship in rural areas and social entrepreneurship.

Another public policy document that contains concrete references is the *Programul de educație și ocupare pentru tineri* [Youth Education and Employment Programme]. From this, we highlight Priority 2 – *Harnessing the potential of young people in the labour market (youth employment)*, which also includes measures aimed at stimulating entrepreneurship. We further note section 2.a.3., the text of which is reproduced verbatim below:

Action 2.a.3. *Activating the entrepreneurial potential of young people* through:
(a) the development of entrepreneurial competences, tutoring/mentoring, assistance/counselling/coaching for young individuals with initiative within

organisations, the promotion of role models, training in project, organisational, or strategic management, and exchanges of experience with Romanian youth from the diaspora; (b) the provision of grants for the creation of new jobs through business start-ups, including within the social economy sector, as well as business incubators for which premises will also be made available within unused buildings owned by local administrative units (LAUs); (c) post-establishment assistance and consultancy (Programul..., p. 4).

It is further stipulated that:

Action 2.a.3 will be implemented through administrators of youth entrepreneurship schemes (public and private accredited higher education institutions; doctoral and postgraduate schools with legal personality, including partnerships between these and the private sector/research and development centres; accredited research institutes/centres, including research institutes of the Romanian Academy; the Romanian Academy; professional associations; chambers of commerce and industry; institutions and organisations that are members of Regional Pacts and Local Partnerships for Employment and Social Inclusion; authorised public and private providers of continuing vocational training; trade unions and employers' organisations; members of Sectoral Committees and Sectoral Committees with legal personality; non-governmental organisations). The types of actions have been assessed as compatible with the DNSH (Do No Significant Harm) principle, given that, by their nature, they are not expected to have any significant negative impact on the environment. (Programul..., p. 44)

Furthermore, for students, a system to promote entrepreneurship has been established through public administrative action, confirmed by an order of the Ministry of National Education. This system involves the organisation and operation of *Student Entrepreneurial Societies*, which promote entrepreneurship within universities and provide financial support for entrepreneurship projects developed by students (Ordin nr. 3262/2017). In support of students under the age of 30 who establish a business, the normative framework provides exemptions from taxes and fees related to company registration (Hotărâre nr. 166/2003).

These public policy documents reflect the directions towards which the Romanian public system seeks to guide society, including emphasising the role of entrepreneurship and enhancing the attractiveness of this career path for young people.

To correlate public policies with the state of entrepreneurship development in Romania, we examine the impact of these policies and programmes as reflected in statistical data. As of February 2026, the total number of companies established by students amounts to 20,032, of which 7,574 are currently operational (plus other statuses). At the same date, at the national level, active professionals (authorised natural persons/individual enterprises/family enterprises) total 455,635, of whom 57,348 are under the age of 29 (12.58%). The total number of partners/shareholders is 1,719,237 natural persons, of whom 7.97% are under 29 years of age, while the total number of legal entities amounts to 1,297,988 (Oficiul Național...).

The level of entrepreneurial development in Romania is positioned at the midpoint of the Romanian Entrepreneurship Index, reaching a score of 49.5 (out of 100) at the end of 2025, representing an increase of 0.5 points compared to 2024. This places Romania in the category of moderate entrepreneurship (the Index comprises four levels: critical entrepreneurship - 0-25

points, moderate entrepreneurship - 25-50 points, emerging entrepreneurship - 50-75 points, and solid entrepreneurship – 75-100 points) (IMM Romania, 2025).

Empirical Research Results

The empirical research was conducted through the administration of a questionnaire designed in digital format and distributed online. The reference population consists of young people in Romania who are currently engaged in the educational process (students) across various higher education institutions in the country.

The convenience sample comprises 389 students who completed the questionnaire by accessing the distributed link (within university centres, through lecturers, or via student associations). The gender distribution favours female respondents, who account for 67.9% (264 students) of the total sample. Male respondents total 125 students (32.1%). In terms of residential background, 285 students (73.26%) come from urban areas, while 104 students (26.73%) come from rural areas.

The age distribution of the sample is presented in Table 1. In the sample, the proportion of respondents aged between 18 and 30 years is 82.78% (322 students). Among the students in the sample, there are also individuals aged 36 years and above, representing 15.16% of the total. These participants were retained in the study, as it was considered that completing a university degree provides diverse perspectives regarding professional trajectories.

Table 1. Age distribution of respondents

Age groups	Number of respondents	Percentage of total respondents (%)
18-22 years	265	68,12
23-25 years	40	10,28
26-30 years	17	4,37
31-35 years	8	2,05
36 years and older	59	15,16
Total	389	100

Source: generate by author

Although regionally unbalanced, the coverage reflects a sample representation of the eastern half of Romania. The numerical distribution of respondents by development regions is summarised in Table 2.

Table 2. Distribution of respondents by development region of residence (number of individuals)

Nord-Est	Nord-Vest	Sud-Vest	Sud-Muntenia	Centru	Sud-Est	Bucureşti-Ilfov	Vest	Total
74	2	21	57	7	126	98	4	389

Source: generate by author

The composition of the sample by field of study/specialisation includes students from the polytechnic field (112 participants), economics/marketing (50 participants), social sciences (45 students), agronomy (38 students), transport (38 students), human resources (25 students), natural sciences (17 students), medicine/health (10 students), political science (7 students), psychology/education (7 students), law (6 students), public administration (6 students), and other specialisations (28 students).

Young People's Perceptions of Identification with Entrepreneurial Status. The prospect of becoming an entrepreneur was analysed in relation to its perceived attractiveness (the possibility of achieving a high financial standard), the associated risk (the risk of losing the investment), and the perceived misalignment with personal style and resources (skills). Table 3 presents the distribution of responses from the study participants.

Table 3. Identification with Entrepreneurial Status

Item: The idea of being a businessperson currently seems to me...	Number of students	Percentage of total students (%)	Number of female students	Percentage of female students (%)	Number of male students	Percentage of male students (%)
Attractive (appears to offer many opportunities for economic development)	207	53.21	127	48,11	80	64
Risky (possibility of losing invested money)	93	23.91	69	26,13	23	18,4
Unsuitable for me (I lack the skills; I would not manage to run a business)	69	17.74	52	19,7	17	13,6
Don't know	20	5.14	16	6,1	5	4
Total	389	100	264		125	

Source: generate by author

The study findings indicate that participants predominantly perceive entrepreneurship as attractive (53.2%), though a notable proportion also regard it as risky (23.9%). Approximately 17.7% of respondents consider the role of a businessperson unsuitable for themselves, while 5.1% were undecided.

The fact that half of the surveyed students are attracted by the prospect of becoming entrepreneurs corresponds with the presence of human capital that could potentially generate private initiatives to support the functioning of the economic mechanism. At the same time, we consider that the portion of young people who perceive the idea of being an entrepreneur as risky does not automatically preclude the possibility of starting a business. The perception of being unsuitable for this type of activity, due to a lack of inherent skills, is more frequently observed among female respondents than male respondents.

Young People's Perceptions of Entrepreneurs. Based on the premise that the choice to become a “businessperson” may be driven by a desire for identification (following the example of a successful role model), we employed four descriptive items (two items with a positive connotation and two items with a negative connotation) to characterise entrepreneurs, drawing on various images captured from informal contexts. Table 4 presents the distribution of responses, which allows for the identification of how the surveyed youth perceive the entrepreneurial population

Entrepreneurs are predominantly perceived as individuals who work diligently, devote substantial time, prepare thoroughly to expand their businesses, and uphold the principles of the market economy, with 75.6% of young people expressing this positive view. This perception is notably stronger among female respondents, who place particular value on effort and honest work, compared with male respondents.

Table 4. Young People's Perceptions of Entrepreneurs

<i>Item:</i> Those currently engaged in business are:	Number of students	Percentage of total students (%)	Number of female students	Percentage of female students (%)	Number of male students	Percentage of male students (%)
Individuals who work hard and honestly to increase both business and personal profit	153	39.33	106	40,15	47	37,6
Individuals who dedicate considerable time to preparation and who believe in the principles of the market economy	141	36.25	95	35,98	46	36,8
Individuals who resort to risky practices, attempting to circumvent the law, as they would otherwise be unable to run the business	47	12.08	31	11,74	16	12,8
Individuals who are lucky and become wealthy, sometimes through deceit	28	7.20	18	6,82	10	8
Don't know	20	5.14	14	5,3	6	4,8
Total	389	100	264		125	

Source: generate by author

Nonetheless, a portion of young people still hold a negative perception of entrepreneurship, associating it with risk, circumvention of the law, and even immoral practices – 19.2% of respondents. This view is more prevalent among male respondents (20.8%) than among female respondents (18.6%).

Young People's Perspectives on Starting a Business. The willingness to start a business depends on a range of conditions. Table 5 presents various situations that may encourage engagement in business, along with the distribution of responses received. This allows for an assessment of whether young people currently consider themselves prepared to manage their own businesses.

Table 5. Key Conditions Influencing the Decision to Start a Business

<i>Item: I would start a business if...</i> <i>(multiple responses could be selected)</i>	Number of students	Percentage of total students (%)
I considered myself sufficiently prepared	286	73,52
I knew the market/economy better.	267	68,63
I learned more about entrepreneurship in high school	76	19,53
I learned more about entrepreneurship at university	96	24,57
It would give me a high social status (appreciation from others).	39	10,02
It would provide me with a lot of money, allowing me to buy many things and feel wealthy	73	18,76

Source: generate by author

It is evident that respondents feel the need to be adequately prepared, which corresponds to well-developed psychological factors capable of supporting the effort required to face the challenges of the market economy. They also require knowledge of the market and market economy.

The prospect that private initiative could ensure personal prosperity does not appear to be a strong motivator for the sample under investigation, and the social status conferred by entrepreneurship exerts the least influence. The need for knowledge of the market economy is indicated by 68.63% of participants, while 75.52% would take this step if they felt sufficiently prepared. Young people require training programmes beginning in secondary and higher education; this can be achieved through the introduction of entrepreneurship courses.

Starting a business requires adequate preparation. A society committed to maintaining a functional economic environment that adheres to the principles of the market economy invests in programmes targeted at the public, whether provided by government institutions or non-governmental organisations. The perceptions of young participants in the study regarding this aspect are summarised in Table 6.

There is a relatively even distribution among young people regarding their awareness of societal resources - such as programmes offered by the state, non-governmental organisations, or family support - that could assist them in entrepreneurial activities.

Nevertheless, the 33.9% of respondents who believe that only their family would provide support is notably high, suggesting low confidence in society's capacity to support young people. This may act as a constraint on private initiative, particularly for those from families with limited financial resources.

Conversely, more than half of the surveyed youth recognise the existence of programmes promoting and supporting entrepreneurship, indicating a satisfactory level of awareness and a strong interest in accessing these opportunities.

Table 6. Young People's Perception of Society's View on Entrepreneurs

Item: I believe that in Romanian society: (only one response may be selected)	Number of students	Percentage of total students (%)	Number of female students	Percentage of female students (%)	Number of male students	Percentage of male students (%)
There are entrepreneurship programmes developed by public institutions that support young people in starting a business	130	33,42	93	35.22	37	29,6
There are entrepreneurship programmes developed by non-governmental organisations that support young people in starting a business	127	32,65	85	32.2	42	33,6
Young people are supported only by their family if they want to start a business	132	33,93	86	32,58	46	36,8
Total	389	100				

Source: generate by author

Society's Image of Entrepreneurs through the "Eyes" of Young People. Considering the influence that public opinion (relatives, acquaintances, the media, etc.) can exert on individual decisions, the study examined students' beliefs regarding how others perceive entrepreneurs. Respondents were therefore asked to indicate what they believe people around them, and society in general, think about entrepreneurs. The distribution of responses is presented in Table 7.

At the level of the student group under investigation, the positive image of entrepreneurs appears relatively limited, with only 57.58% of students selected descriptions in positive terms - people dedicated to their work, personal inclinations and enjoyment of conducting business. In contrast, the proportion of students endorsing negative perceptions - associating entrepreneurs with succeeding through illegal practices and/or enriching themselves at the expense of others' work - rises to 42.42%. Notably, 33.68% chose the description "people who exploit others and their work to enrich themselves," an item that may be associated with a perspective shaped by a communist philosophy, the remnants of which are still present in Romanian society.

Table 7. Societal Perceptions of Beliefs About Entrepreneurs

Item: I believe that those around me (society) consider entrepreneurs to be: ...	Number of students	Percentage of total students (%)	Number of female students	Percentage of female students (%)	Number of male students	Percentage of male students (%)
People who work hard for their business	150	38,56	102	38,64	48	38,4
People who are fascinated by or inclined towards managing a business	74	19,02	54	20,45	20	16
People who exploit others and their work to enrich themselves	131	33,68	88	33,33	43	34,4
People who succeed through illegal practices	34	8,74	20	7,58	14	11,2
Total	389	100				

Source: generate by author

It was considered important to identify the differences between these two perspectives in order to highlight divergences of opinion and to reflect on the conditions under which the perception of others exerts a stronger influence on a young person's decisions and behaviour when organising their career. Public sanction - the idea that others might describe them in negative terms - could serve as a deterrent to initiating a business.

5. Conclusions

The effect of public policies is relative, placing Romania within the sphere of moderate entrepreneurship. Although there are support measures for young people, including students, these are insufficiently utilised. A further study could explore this aspect in greater depth, particularly the extent to which these policies are known and whether information campaigns are being conducted.

The sociological perspective on entrepreneurship among young people highlights the direction in which they are heading: they are attracted to the idea of becoming entrepreneurs, yet they take into account the risks involved, which directs their choices more towards employee status and less towards entrepreneurship. This may affect the long-term resilience of society, as well as the achievement of sustainable development objectives within the occupational sphere, through the imbalance between the number of economic entities providing jobs and the high supply of labour.

From a gender perspective, given that the student population shows a slight predominance of females, it is to be expected that attention should be paid to women's entrepreneurship and to programmes dedicated to this category, in order to overcome attitudinal barriers and stereotypes. This is all the more relevant as the present research has revealed a lack of confidence in their own abilities among female students.

The collective mindset regarding the entrepreneur can be both stimulating and inhibiting for students. In the context of a negative public opinion towards the business environment - rooted in a socialist-type mentality, transmitted particularly through interpersonal relations within the family (e.g. "the employer exploits the work of others in order to enrich themselves") - society faces resistance from a segment of the population to the adoption of a liberal model (based on private initiative and the market economy), alongside an increased demand for state intervention (reflecting adherence to a social model centred on state protection). This may provide an explanation for the moderate level of entrepreneurship in Romania.

The resilience of the state, and implicitly of society, is being put to the test, particularly in the context of pressures arising from demographic ageing, the ageing of the workforce, geopolitical threats, and the diminishing capacity of the state to provide social protection. Thus, the Sustainable Development Goals - particularly those related to sustainable development (Goal 8: Decent Work and Economic Growth, specifically the component concerning the promotion of development-oriented policies that support productive activities, the creation of decent jobs, entrepreneurship through start-ups, creativity and innovation, and that encourage the formalisation and growth of micro-, small- and medium-sized enterprises, including through access to financial services), as well as those concerning recovery and resilience - can be achieved under the conditions of a population willing to assume risks, invest in education, and devote time and effort to attaining economic independence and active socio-economic participation.

Under conditions where adequate public or private support mechanisms are in place to provide training and preparation for business life (beginning in secondary education and continuing into higher education), the majority of young people would opt for private initiative. The development of entrepreneurial competences is necessary and should be incorporated into public education policies and programmes supporting independent economic activity and young entrepreneurs (Institutul European..., 2025). In the absence of young people's origins in an entrepreneurial environment that encourages the decision to start a business (Dumitrasciuc, 2020), policies aimed at shaping an entrepreneurial mindset and supporting businesses initiated by young people are essential, so that the youth population can increase its level of resilience in situations of economic and social crisis.

The development of an entrepreneurial culture at the population level is necessary in order to reduce the gap between Romania and other European countries, thereby fostering increased employment through both job opportunities and entrepreneurial activities

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DESIGNING THE DEVELOPMENT OF GAS TRANSMISSION INFRASTRUCTURE – CHARACTERISTICS, SPECIFICS AND METHODOLOGICAL FRAMEWORK

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Abstract: *This manuscript examines infrastructure projects for the development of the gas transmission network as a specific category of capital investments of key importance for energy security and sustainable economic development. The characteristics of the gas transmission infrastructure are analyzed, such as long-term planning horizon, high capital intensity, strategic importance and regulatory commitment. Special attention is paid to the specific challenges facing these projects expressed in technological complexity, cross-border dimension, environmental requirements and coordination among multiple stakeholders. At the end, the author's vision of a methodological framework for planning, assessment and management of projects in the sector, including technical and economic analysis, risk assessment and compliance with the European regulatory framework, is developed. The conclusions highlight the need for an integrated approach combining engineering, financial and legal competencies in the implementation of such strategic projects.*

Keywords: *Gas transmission network, Gas projects characteristics, European regulatory framework, Technical and economic analysis, Risk assessment.*

Classification JEL: *O14, O22, Q47.*

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1. Introduction

Gas transmission infrastructure occupies a central place in the energy security of modern economies. Investments in it are distinguished by a long-term horizon and high capital intensity. They have strategic importance and are closely linked to the regulatory environment. This significantly distinguishes them from conventional capital projects. The implementation of such projects is accompanied by a number of specific challenges. Technological complexity places high demands on engineering planning. The cross-border dimension requires coordination between various national and supranational institutions. Environmental standards and coordination with multiple stakeholders further complicate the process. This report examines these projects in their entirety.

The aim is to propose a methodological framework for their planning, assessment and management, which would integrate technical and economic analysis, risk assessment and compliance with European legislation. The successful implementation of such projects requires engineering, financial and legal competencies at the same time. The guiding idea is that only an integrated approach can ensure the effective management of strategic investments in expanding the gas transmission network.

2. Literature Review

The development of gas transmission infrastructure in modern conditions requires the application of a comprehensive project approach that integrates technical, economic, environmental and social aspects of the investment process. A number of fundamental

studies in the field of project management in the energy sector argue that the specificity of infrastructure projects in the gas sector is determined by the unique combination of a long-term investment horizon, high capital requirements and strategic importance for energy security (Al-Bdairi, Naji, & Abed, 2025).

These projects have a direct relationship to ecology and environmental protection, which is reflected in the implementation of specific ESG policies by companies in the gas production and gas transmission sectors (Mustafa & Yucel, 2024). These and other studies (Esty, 2004) conclude that infrastructure projects in the gas transmission sector have their own specific and often unique time, financial, technical, environmental (Zahariev, et al., 2023) and social dimensions, with corresponding characteristics, specific challenges and approaches to their management (see Table 1).

Table 1. Characteristics of infrastructure projects in the gas transmission sector

Dimension	Characteristics	Specific challenges	Management approaches
Time	Long-term horizon (20-40 years)	Forecasting uncertainty	Scenario planning
Financial	High capital costs	Complex financial structuring	Innovative financial instruments
Technical	Complex engineering solutions	Technological risks	Integrated risk management
Environmental	Strict environmental requirements	Regulatory compliance	Environmental management
Social	Wide range of stakeholders	Social impact	Inclusive governance

Source: Author analysis

In practice, the question to be addressed is not whether, but to what extent ESG policies and requirements influence the strategic development of the sector and new investments in expanding the gas transmission and supply network (Ramírez-Orellana, Martínez-Victoria, García-Amate, & Rojo-Ramírez, 2024). Through the prism of environmental regulations, there are a number of confirmations in the literature that corporate financial strategy is strongly influenced and should be adapted to the impacts of ESG regulations (Zahariev, et al., 2024b).

ESG regulations achieve a direct impact on the returns of public companies in the gas sector, which is defined as a risk factor with a systematic nature for the industry (Sadorsky, 2001). They are influenced not only by factors typical for the construction sector (Zahariev, Zaharieva, Shaulska, Larysa, & Oryekhov, 2026), but also by additional ones directly related to ESG regulations (Zahariev, et al., 2024a).

3. Methodology

The methodology of the study is based on the concept of the decisive importance of the prior institutional structuring on the success of investments in gas transmission infrastructure, compared with the technical characteristics and engineering implementation (Miller, Lessard, Michaud, & Floricel, 2001). The institutional framework of project management in the gas transmission sector is characterized by a complex architecture of interacting organizations and regulatory mechanisms. In practice, we support the concept of multi-layered project management, which integrates the different levels of decision-making - from strategic planning to operational implementation.

The institutional responsibilities in project management are distributed across four levels. Each of them performs specific functions and produces specific results (EIB, 2005). At the strategic level, policies are formed that determine the direction of development. Coordination is carried out through interdepartmental working groups (Herrera, Sánchez, Castañeda, & Porras, 2020). The result of this activity are the strategic documents on which the overall management framework is built (Ushenko, et al., 2023). The regulatory level is responsible for the control and supervision of implementation. It functions through established regulatory procedures and creates the permitting regimes without which no project can start (Gatti, 2007). The operational level is where projects are actually implemented. Project teams are the main coordination mechanism at this level, and their final product is the infrastructure facilities themselves (Zahariev & Prodanov, 2017). The monitoring level closes the management cycle. It evaluates the achieved results through specialized monitoring systems (Quarton & Samsatli, 2018). The output of this activity are the reports and analyses that inform subsequent management decisions.

The scientific literature in the field of infrastructure projects and especially in the gas transmission sector has demonstrated significant evolution over the last decade, reflecting the increasing complexity of the challenges facing the industry (Al-Yafei, et al., 2026). In a fundamental study from 2025, focused on the lessons of infrastructure megaprojects, a conceptual framework for analyzing the specificity of gas transmission projects is developed, emphasizing their strategic importance and long-term impact on the energy system (Lou, Afshari, Johansen, Nygaard Rasmussen, & Bohne, 2025). The authors argue that traditional approaches to project management do not sufficiently consider the unique characteristics of infrastructure projects and the need for an integrated approach to their development.

The analysis of the contemporary scientific literature reveals several dominant research directions. First, the strategic aspects of infrastructure development are considered, emphasizing the need for long-term planning and integration with energy policy (Hadi, Supomo, Achmadi, & Baihaqi, 2026). Research demonstrates that the successful implementation of gas transmission projects requires a thorough understanding of geopolitical factors and trends in the development of global energy markets (Rqiq, Beyza, Yusta, & Bolado-Lavin, 2020). In addition to economic considerations, attention is focused on the technological aspects of project implementation (Kaulbeck, 2015). The analyses reveal the growing importance of innovative technological solutions for increasing the efficiency and reliability of gas transmission infrastructure.

In methodological terms, modern research demonstrates a trend towards integrating different analytical approaches. Priority is given to a complex methodological framework combining quantitative and qualitative methods for analyzing infrastructure projects (Lewis & Mervyn, 2004). This methodology allows for a more precise assessment of project risks and more effective resource management. The most innovative approaches to project risk assessment are based on the use of artificial intelligence and machine learning. Their results demonstrate significant potential for improving the accuracy of risk assessments and optimizing management decisions.

4. Results and Discussion

The world's entry into a series of energy crises caused by military conflicts, sanctions and blockades of sea routes has led to a review of natural gas supply chains, whose conservative matrix connected the point of the deposit with the sales markets through pipeline infrastructure. The new technological solution for gas transmission via LNG tankers has led to the need for accelerated investments in gasification and regasification terminals. Due to the impossibility of natural gas being transported by sea in its gaseous state, installations for liquefaction at -162°C and subsequent transportation by tankers are being built. Thus, investments in regasification terminals are being put at the forefront of natural gas supply chains. Their financing is also developing new bond instruments, which have gained popularity as “green bonds” (Alonso-Conde & Rojo-Suárez, 2020).

The terminals themselves are industrial facilities whose main purpose is to receive liquefied natural gas, store it and convert it back into gas for the distribution network. In this way, the terminals connect maritime transport with the land-based gas transmission infrastructure and form a critical node in the global supply chain. Regasification terminals already play a significant role in the security and diversification of energy supplies. They can receive natural gas from anywhere in the world and provide flexibility by increasing or decreasing production depending on demand. This makes them a tool not only for the physical transportation of gas, but also for managing market risk (Pavlov & Kostov, 2023). From a technological point of view, investments are focused on two main types of terminals. Land-based terminals have permanent infrastructure and large storage capacity. Floating storage and regasification units (FSRU) are preferred due to their shorter commissioning times and lower initial costs compared to land-based terminals.



Figure 1. Alexandroupolis and Thrace LNG Terminals as entry point for gas delivery to SEE

Source: Gastrade, 26th National Energy Congress “Energy + Development 2022”, 22-23.11.2022

The importance of these facilities is growing in the context of energy security. Events after 2022 and the reduction of Russian supplies through the underground pipeline network have accelerated the construction of new terminals in Europe. Of particular importance for the Balkan Peninsula and South-eastern Europe is the investment in the LNG terminal at Alexandroupolis (See Figure 1).

The Alexandroupolis LNG Terminal Project is an initiative of the Greek company Gastrade, founded in 2010, with the aim of designing, building, operating and managing an infrastructure for the reception, transmission and distribution of natural gas. It is positioned as the most significant new infrastructure project for energy security and diversification in the South-Eastern European region. The project is a response to a structural vulnerability in the region. The countries of Central and South-Eastern Europe are dependent on Russian gas by about 60%, or 22–23 billion cubic meters per year by 2021. The only alternative infrastructures in operation are the TAP gas pipeline and the LNG terminals in Revithoussa (Greece) and Krk (Croatia). The Balkan and SEE markets are among the few European markets with an expected growth of about 10% in the period 2021–2030, which further justifies the need for the project.

The terminal is built on the basis of a floating storage and regasification unit (FSRU), positioned about 15 km southwest of Alexandroupolis, about 8 km from the coast. The facility has a storage capacity of 170,000 to 185,000 cubic meters of LNG and a maximum regasification rate of 650,000 Nm³/h, corresponding to about 6 billion cubic meters per year (See Figure 2). The permanent infrastructure includes a mooring system, a pipeline and a connection to the Greek National Gas Transmission Network and/or TAP. In addition, a second Thrace LNG terminal is being developed, which will operate in parallel with the main one.

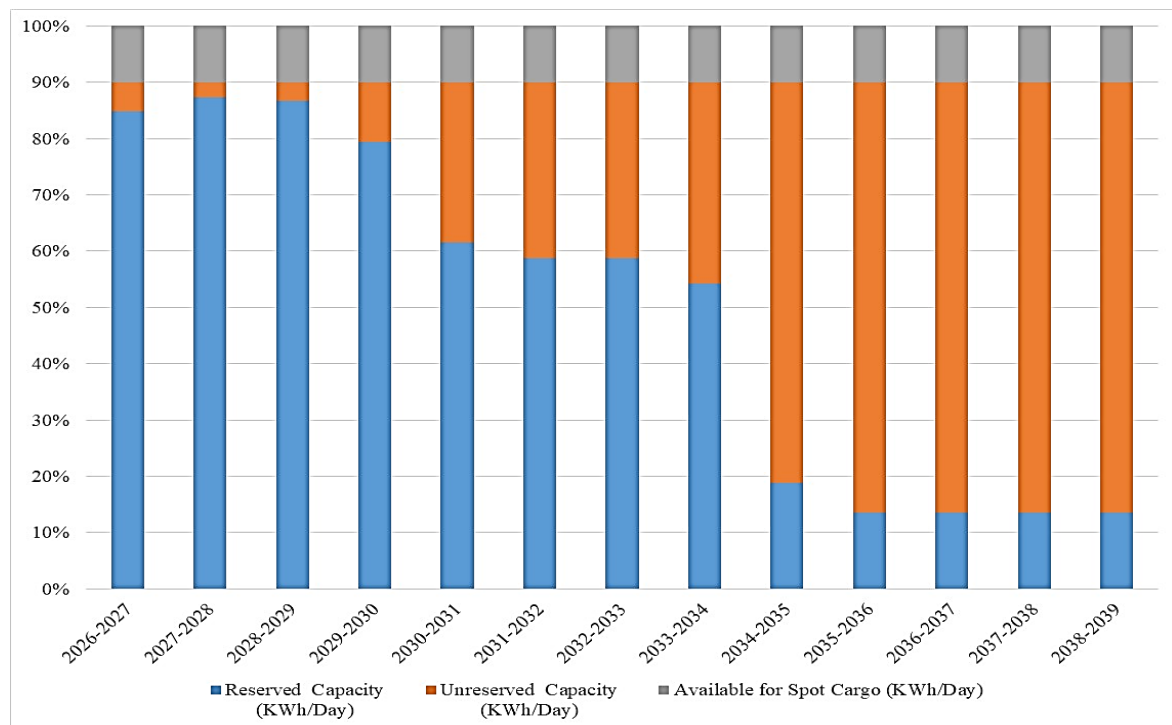


Figure 2. Capacity of Alexandroupolis LNG terminal (2026-2029)

Source: Visualization by the author based on data from Gastrade, <https://tutps.gastrade.gr/public-documents>

The estimated investment value of the project amounts to 510 million euros. The financing is structured through a combination of debt financing and grants, co-financed by Greece and the European Union. Gastrade is the operator of the facility and is structured with equal participation of five partners, each with a 20% share: Elmina Copelouzou, Gaslog Cyprus Investments (a leader in marine LNG transport), DEPA Commercial (the public gas company of Greece), Bulgartransgaz (the operator of the Bulgarian gas transmission network) and DESFA (the Greek gas transmission network operator). This balanced capital structure (Zahariev A., 2014) acts as an amplifying factor for the constant loading of the capacity of the facility. Gastrade was licensed in 2015 and the market test was conducted until 2017. After securing debt financing, construction works and laying of pipelines began. The floating platform was built at the Seatrium shipyard in Singapore and transported to the anchorage in Alexandroupoulos Bay between 26.11-17.12.2023.

The facility was officially opened on 1.10.2024 with a daily technical regasification capacity of 181.5 GWh/day, which covers the consumption of nearly 5 million households. Through the network of already built interconnections and underground gas pipelines, the facility supplies gas to consumers in 9 countries - Greece, Bulgaria, Romania, North Macedonia, Serbia, Moldova, Ukraine, Hungary and Slovakia. By 2030, the facility has a reserved capacity of 84.6%.

In light of the new crisis with the Gulf War and the blockade of the Strait of Hormuz, LNG regasification terminals are becoming much more than technical facilities (Esty, 2004). They are strategic assets that determine the degree of energy independence, supply diversification, flexibility of national gas systems and price balancing (Zahariev & Kostov, 2016). Therefore, access to LNG import terminals and markets is becoming increasingly important within the framework of regional energy strategies, especially in the EU, where the aim is to increase resilience to supply disruptions.

5. Conclusions

Empirical and theoretical research in the field provides valuable data on the practical aspects of project implementation. In the analysis of implemented projects in the European gas sector and especially the Alexandroupolis LNG terminal project, the key success factors of project failures are identified. The conclusions from these studies are of great importance for improving project practices and minimizing risks.

The review of the scientific literature demonstrates the significant progress in understanding the specifics of infrastructure projects in the gas transmission sector. At the same time, new research challenges are outlined, related to the need to adapt to changing technological and market conditions. The presented literature review reveals the wealth of scientific research in the field and emphasizes the need for an integrated approach to the analysis and management of infrastructure projects in the gas transmission sector.

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TECHNOLOGICAL PROGRESS: TOWARDS A THEORETICAL PERSPECTIVE

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Abstract: *Technological progress is a primary engine of economic growth, yet its acceleration carries costs – technological unemployment, widening inequality, capital obsolescence, and rising socio-economic and cybersecurity risks – that may offset its benefits. This paper asks whether the negative consequences of scientific and technological progress outweigh the positive ones, and how a sanctioned economy such as Belarus pursues technological sovereignty under these conditions. The study combines a qualitative analysis of the theoretical literature with a comparative review of national models of technological development in China, the European Union, the United States, Africa, and Latin America, drawing on data from the National Statistical Committee of the Republic of Belarus and the State Committee on Science and Technology. The analysis identifies the main channels through which technological progress affects growth and maps the dominant characteristics and negative effects of progress across regions. For Belarus, the science intensity of GDP rose to 0.59% by the end of 2024, the number of organisations performing research and development reached 463, and the innovation infrastructure expanded to 16 science and technology parks hosting 274 residents. The findings suggest that Belarus has not yet encountered the adverse effects of technological progress; rather, the isolation imposed by sanctions appears to accelerate its drive toward technological sovereignty. The paper argues that activating the country's innovation, start-up, and entrepreneurial ecosystems is the decisive condition for sustaining this trajectory.*

Keywords: *technological progress, negative impact, positive impact, sanctions.*

Classification JEL: *O10, O30, O38.*

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1. Introduction

Scientific and technological progress is one of the main sources of economic growth and development. Its positive impact is measured by the development of artificial intelligence and big data, neural networks, biotechnology and medicine, space technology, and other areas. However, scientific and technological progress also has negative aspects, including job losses, increased inequality, environmental pollution, the side effects of green energy, technology dependence, cybersecurity, and others. All of this has led to the hypothesis that the negative consequences likely outweigh the positive impact of scientific and technological progress. It is also worth considering the experience of Belarus as a country on the path to scientific and technological progress, yet living under various sanctions.

2. Literature Review

Gichiev (2013), analyzing theoretical aspects, identifies two periods in the modern stage of economic growth research: models that explain the sources of growth using external effects of learning by doing and human capital, thereby motivating the absence of diminishing marginal productivity; the second series of new wave models focused on explaining the

origin of technological progress and a detailed development of the structure of the emergence and implementation of innovations.

Gaipov et al. (2024) argue that innovation plays a central role in modern economic development, contributing to productivity growth and the creation of new opportunities. It influences all aspects of the economy, facilitating its dynamic development.

Technological progress plays a vital role in economic growth and development. Belyakov and Kochemaskin (2014) note that at the current stage of development, the direct influence of scientific and technological progress is becoming one of the key factors in economic growth and improving the well-being of the population in most industrialized countries.

In this regard, the study by Galor and Tsiddon (1997) is important. They state that in periods of major technological inventions, a decline in the relative importance of initial conditions raises inequality, enhances mobility, and generates a larger concentration of high-ability individuals in technologically advanced sectors, stimulating future technological progress and growth. However, once technologies become more accessible, mobility is diminished and inequality decreases but becomes more persistent. The reduction in the concentration of ability in technologically advanced sectors diminishes the likelihood of technological break-throughs and slows future growth. User friendliness, therefore, becomes unfriendly to future economic growth.

Despite the positive impact of scientific and technological progress on economic growth and development, there are also negative aspects. As Berdieva et al. (2024) write, technological progress is an important factor in economic growth. This leads to increased productivity, which, in turn, leads to improved economic performance. However, technological advances can also lead to demand-pull inflation, which can limit economic growth.

Ayres (1996) notes that increasing welfare is due primarily to science and technology, and only secondarily to economic growth. Scientific and technological progress generated economic growth, not vice versa. In its present form, economic growth can hinder technological progress (through increasing returns to scale reducing the rate of innovation). But current technological progress can negatively impact economic growth, and especially in the field of information technology.

3. Methodology

This study utilizes both qualitative and quantitative research methods to enhance readers' understanding of issues related to scientific and technological progress. Specifically, it analyzes the views of various scholars on the role of scientific and technological progress in economic growth and development. Qualitative analysis is used to identify the positive and negative aspects of scientific and technological progress, thereby providing a theoretical basis for further research. The analysis of scientific and technological progress is based on data from the National Statistical Committee of the Republic of Belarus, the State Committee on Science and Technology, and other online sources.

4. Results and Discussion

Our study draws on the work of Égert (2026), who builds on the innovation-led growth research of the 2025 Nobel laureates in economics – Joel Mokyr, Philippe Aghion, and Peter

Howitt – and on the broader evolution of modern growth theory and empirical evidence. Building on these concepts, Égert interprets the widespread slowdown in productivity growth observed in advanced OECD countries since the mid-2000s and argues that the key explanatory factors include a decline in creative destruction, a slowdown in the diffusion of advanced technologies, a decline in business dynamism, and the negative impact of policy. From our point of view, key aspects of the negative impact of technological progress:

- Technological unemployment: The replacement of humans by machines and artificial intelligence (AI) is leading to the disappearance of a number of professions. In the short term, this creates an imbalance in the labor market, as workers are unable to retrain quickly.
- Growth of inequality: Technology increases the demand for highly skilled workers, raising their incomes, while the wages of low-skilled workers stagnate or decline, exacerbating social inequality.
- Structural shifts and obsolescence: Rapid technological change makes previously acquired equipment (capital) unprofitable. This forces companies to write off old assets and incur the costs of implementing new ones, which can slow growth in certain sectors.
- Socioeconomic risks: Technological development requires significant expenditures on training and retraining of personnel and also carries risks related to AI ethics and data protection.

Based on the analysis of various opinions of scientists, the Classification of Regional Economic Stability Factors was identified: dominant technology and techniques in society; state economic policy; Operational; Market; Investment; Other.

Key features of endogenous scientific and technological progress can also be highlighted:

- Learning-by-doing: Productivity growth occurs automatically with increasing production scale.
- Investment in knowledge: Technological progress is generated by the activities of scientific schools, personnel development, and R&D expenditures.
- The role of government: Government policy influences the rate of endogenous scientific and technological progress through support for education, science, and the creation of innovation infrastructure.

After conducting an empirical study of technological progress and economic growth based on statistical data from 1999 to 2013 in Anhui Province, Ding (2015) states that firstly, technological progress and economic growth are a long-term stable equilibrium relationship, with each increase of 1% of technological progress increasing economic growth by about 0.6%; secondly, technological progress and economic growth are the causal relationship between granger. Thirdly, when the impact of technological progress comes into being, it can bring more long-term, positive influence to economic growth.

The interaction between digital platforms and technological innovation on economic growth deserves special attention. Considering the case of China based on panel data from 30 Chinese provinces for the period from 2013 to 2023, Chinese scholars conclude that unobserved heterogeneity and a solution to the heteroscedasticity problem are absent. The results show that digital platforms have a statistically significant and positive impact on economic growth: a 1% increase in digital platform activity is associated with 0.0344% economic growth. Moreover, the

interaction between digital platforms and technological innovation further enhances this effect, contributing to an additional 0.0378% economic growth. This finding highlights the relationship between digital platforms and technological innovation, emphasizing the importance of integrated policy frameworks that promote both digital development and technological progress to support economic growth in China (Li et al., 2026).

An important aspect of scientific and technological progress is innovation in the military-industrial complex. A study by Zhu et al. (2024) examines the impact of military-industrial base financing efficiency on non-technological innovation, based on Chinese data. Noting that innovation in the military-industrial base requires not only technological progress but also scientific organization and management, as well as a sound business model, the authors establish that military-industrial base financing efficiency has a significant positive impact on organizational and market innovation, which is especially noticeable in state-owned enterprises and military companies. The mechanism of influence lies primarily in improving information symmetry and reducing agency costs.

By analyzing the structure of government expenditure, technological progress and economic growth, Liu et al. (2023), based on the construction and estimation of the New Keynesian endogenous technological progress model and using the time series data of Chinese macroeconomics from 1996 to 2019, conclude that compared with the traditional dynamic stochastic general equilibrium (DSGE) model, the endogenous process of technological progress enhances the impact of government consumption shock and traditional government investment shock on the macroeconomy, which leads to stronger fluctuations in the business cycle.

The analysis made it possible to identify the main features of scientific and technological progress in various countries and regions (Table 1).

Table 1. Main characteristics of scientific and technological progress in different countries and regions

China	Europe	USA	Africa	Latin America
<i>Main characteristics of scientific and technological progress in different countries and regions</i>				
A successful model of transformation from a backward economy to a global technological leader through strong government planning, massive investments in R&D, and the development of quantum technologies, artificial intelligence, space exploration, and electric vehicles. Key factors include talent development, commercialization of innovations, and the goal of becoming a scientific superpower.	based on the integration of science and industry, the active role of the state in funding innovation, creating technology platforms, and supporting small and medium-sized enterprises. Key elements include research commercialization, venture capital financing, and a focus on sustainable development, ensuring high competitiveness.	is based on a powerful synergy between government, private industry, and universities, ensuring the US leadership in AI, aerospace, and bioengineering. Key factors include high R&D spending (41% of global high-tech production), a flexible venture capital system, effective technology transfer, and intellectual property protection.	a unique blend of ancient innovations and rapid modern development focused on mobile technologies, fintech, and green energy. The continent is rapidly transforming into a startup hub, overcoming infrastructural limitations through digitalization, with South Africa, Egypt, Nigeria, and Ghana emerging as key players.	characterized by attempts to transition from a raw materials-based model to an innovative one through economic integration, the development of paradiplomacy, and the creation of regional scientific and technological relations. Key focuses include economic diversification (Chile), support for innovation policy, and the adaptation of international technologies.
<i>The main components of the experience</i>				
• Strategic Planning and Financing: The state sets strict goals, backed by extensive funding. Priority is given to industrial development and achieving technological sovereignty. • Development of Breakthrough Technologies: China has become a leader in quantum cryptography, communications, computing, artificial intelligence (AI), and electric vehicle production.	Integration of Science and Technology Policy: The EU is creating a common space where technology policy is aligned with political objectives, facilitating the rapid adoption of innovation. Technology Platforms: National and pan-European platforms bring together business, science, and government to define research priorities. Venture Capital: The government acts as a catalyst, reducing risks for private	High R&D spending: The United States consistently ranks among the world's leaders in research and development spending. Science-Business Collaboration: Universities such as MIT, Stanford, and Berkeley actively commercialize scientific research by creating startups. Government Role: Public funding is often directed toward fundamental research and strategic sectors (defense, space,	Leapfrogging: Africa often skips intermediate stages of development, adopting cutting-edge technologies immediately. A prime example is the M-Pesa mobile payment system in Kenya, which has provided financial access to the unbanked population. Startup Continent: Nigeria, Ghana, and Kenya are seeing a growing number of innovative companies in fintech, agritech, and healthcare.	• Integration Processes: The Latin American Integration Association (LAI) brings together 12 countries to create a common market and collaborate on technology. • Innovation Policy: Countries in the region, such as Brazil and Chile, are actively implementing measures to support innovation and industrial modernization. • Economic Diversification: Chile offers a successful example, where mining, agriculture, and services have

• Integration of Science and Business: An effective model for commercializing innovations, whereby research results are quickly implemented into production. • Attracting Talent: Actively working to bring back specialists from abroad and create conditions for young scientists. • International Cooperation: China is actively leveraging the experience of international scientific and technological cooperation to accelerate its own development.	investors and stimulating the development of start-ups. The Role of SMEs: Small and medium-sized enterprises (SMEs) play a crucial role in the innovation economy, ensuring flexibility and the rapid adoption of new technologies. Sustainability and Security: Particular attention is paid to green technologies and managing the social impacts of automation.	AI), mitigating risks for private investors. Venture Capital: A well-developed venture capital ecosystem (Silicon Valley) enables the rapid scaling of promising technologies. Flexible Manufacturing: Focus on high-tech, diversified, and small-scale production that adapts to market demands. Human Capital: Attracting top scientific talent from around the world through a high-quality education system and immigration policies.	Scientific and Educational Potential: Despite challenges, African countries (especially South Africa and Egypt) are building their research capacity, participating in global technological transitions. Agricultural Innovation: The introduction of improved crop varieties (for example, in Ghana) significantly increases farm productivity.	become drivers of technological development. • International Cooperation: Developing scientific and technological relations with other regions (for example, with Russia) is an important element in enhancing competitiveness.
<i>Key achievements (key areas of leadership)</i>				
• Advances in quantum radar, metrology, and navigation. • Launch of the Shenzhou spacecraft. • Leadership in the production of eco-friendly vehicles.	Green Technologies and Energy: The EU is a global leader in developing technologies to combat climate change, develop renewable energy sources (RES), hydrogen energy, and clean manufacturing. Digitalization and AI: Active development of quantum technologies, cybersecurity, artificial intelligence (AI), semiconductors, and digital infrastructure, aimed at ensuring technological sovereignty. Biotechnology and Life Sciences: High-level research in	Artificial Intelligence and Big Data: Leadership in neural network development. Biotechnology and Medicine: Development of advanced prosthetics and treatments. Space Technologies: Private companies (SpaceX, Blue Origin) are changing the industry.	Digital Economy and Fintech: Leadership in mobile payments (M-Pesa), mobile app development for services, e-commerce development, and innovative banking solutions (especially in Kenya and Nigeria). Agritech (AgTech): Innovation for sustainable agriculture, precision farming, drought management, and crop yield improvement. Green Energy: Active development of renewable energy sources (solar, wind,	Aerospace: Brazil (Embraer) is a world leader in civil aircraft production. Nuclear Energy and Nuclear Technologies: Argentina and Brazil are developing their own nuclear power cycle technologies, designing and constructing nuclear power plants. Agricultural Biotechnology: Highly developed plant genetics, developing resistant varieties (soybeans, corn), and precision farming technologies. Mining and Metallurgy: Implementation of robotic

	genetics, medical biotechnology, pharmaceuticals, and the bioeconomy. Aerospace: Development of advanced space technologies, satellite systems, and aerospace research. Materials Science and New Materials: Creation of composite materials, nanotechnology, and advanced materials for industry. Industry 4.0: Implementation of comprehensive automation, digitalization of production processes, and robotics.		geothermal) to overcome energy shortages. Biotechnology and Medicine: Development of local vaccine production (e.g., in South Africa and Senegal), use of digital medicine (telemedicine), and diagnostic technologies. Space Technologies: Countries (Egypt, South Africa, and Nigeria) are developing and launching their own satellites for resource monitoring, communications, and geodesy. Innovation Hubs: Growth of technology clusters supporting startups in AI, big data, and IoT, enabling high levels of innovation activity exceeding	systems and smart technologies for copper (Chile) and oil (Brazil, Mexico) mining. Renewable Energy: Leadership in the use of hydropower and the introduction of solar and wind energy technologies. IT and Fintech: Development of digital platforms, fintech, and startups (especially in Brazil and Mexico).

Source: own scientific research

The analysis allowed us to identify the main negative elements of scientific and technological progress in the analyzed regions and countries (Table 2, 3).

Table 2. The main negative consequences of scientific and technological progress in China, Europe and the USA

China	Europe	USA
Environmental crisis Technological dependence Socioeconomic problems Digital limitations Economic imbalance Intellectual property issues Demographic challenges	• Socioeconomic issues: Job loss Growing inequality Decreased competitiveness • Environmental risks: Pollution Side effects of green energy • Technological and personal risks: Technology dependence Cybersecurity Deteriorating health	• Socioeconomic issues: Automation and unemployment Digital addiction Erosion of privacy • Cultural and psychological changes: «Virtualization» of life Depersonalization • Technological and scientific risks: Cybersecurity Slowing scientific discovery • Environmental consequences: Pollution

Source: own scientific research

Table 3. The main negative consequences of scientific and technological progress in Africa and Latin America

Africa	Latin America
Digital Divide and High Costs Environmental Risks Economic Dependency Social Instability Infrastructure Inadequacy	Technological Dependency and Brain Drain Environmental Issues Socioeconomic Inequality Economic Vulnerability

Source: own scientific research

Belyakov and Kochemaskin (2014) identify the following key areas of scientific and technological development: the creation and use of advanced technologies; technological modernization of economic sectors; development of high-tech production (goods and services); formation and development of technological infrastructure; development of applied technological science; increasing the level of technological competencies of personnel.

According to various scholars, the channels through which scientific and technological progress influences economic growth include the following areas: technology diffusion (foreign direct investment, imports, international trade; investments, imports, international trade); market competition (technological frontier, incentives for innovation, imitation, frontier, incentives for innovation, imitation); credit constraints (human capital, investments); human capital (innovations, imitation).

We agree with Brown and Ulijn (2004) that any technological progress, innovation or economic growth created by an organization depends on how the culture and environment of this organization contribute to or hinder these processes.

The analysis revealed that the science intensity of Belarus's GDP by the end of 2024 increased and amounted to 0.59% (Fig. 1).

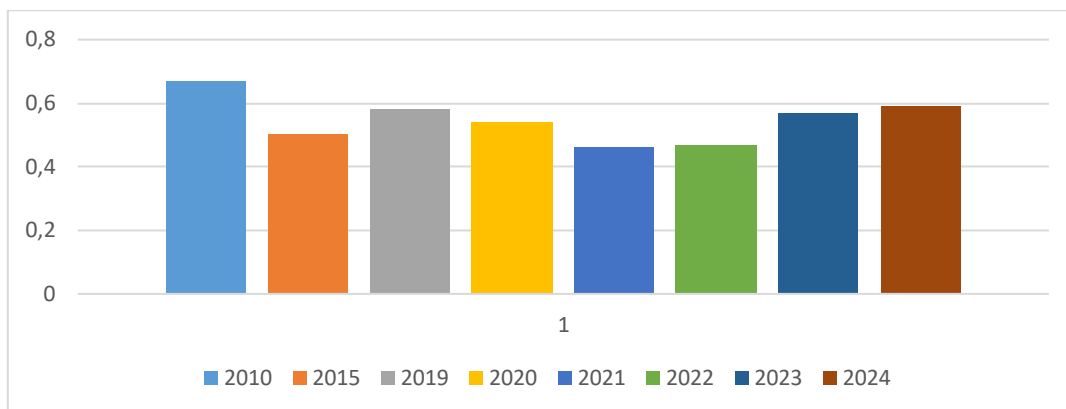


Figure 1. Science intensity of Belarus's GDP in the period 2010-2024

Source: compiled by the author based on data from the National Statistical Committee of the Republic of Belarus

Based on the view of Liu et al. (2023) that public investment in science and technology has a positive external impact on firms' research and development activities and the application of innovative achievements, and that in the long term it can contribute to more sustainable economic growth than government consumption and traditional investment, we analyze the types of R&D expenditures by sector.

An analysis of the types of R&D expenditures by sector revealed that, by the end of 2024, the commercial organizations (entrepreneurial sector) sector is the leader (Figure 2).

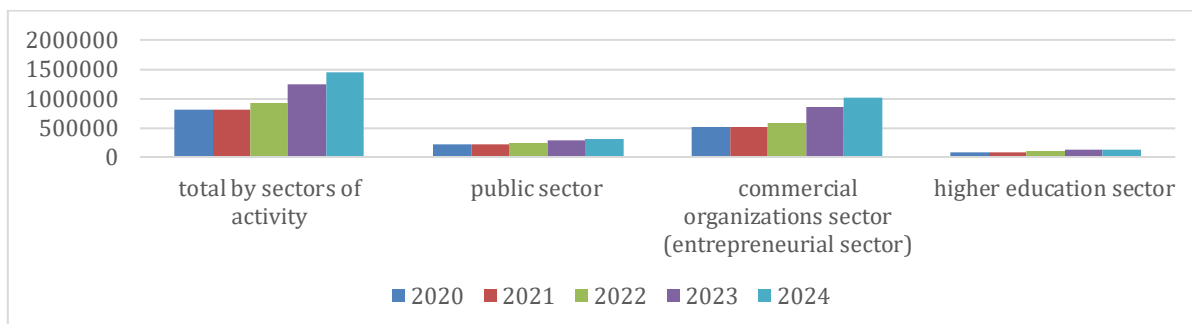


Figure 2. Domestic expenditure on scientific research and development in the Republic of Belarus in the period 2020–2024, in thousands of rubles

Source: compiled by the author based on data from the National Statistical Committee of the Republic of Belarus

The analysis showed that the number of organizations carrying out scientific research and development in the Republic of Belarus increased and amounted to 463 units by the end of 2024 (Fig. 3).

The analysis showed that the largest number of organizations that carried out scientific research and development in the regions of the Republic of Belarus in the period 2020-2024 are in the commercial sector (entrepreneurial sector).

In terms of the activities of intellectual property protection institutions, the study by Nazeer and Rasiah (2024) is valuable in analyzing the role of institutional quality in Pakistan in technology transfer, technological progress, and economic growth. Examining the role of institutions in Pakistan's efforts to stimulate technological progress, specifically analyzing the evolution of institutional quality, technology transfer through technical cooperation grants, technological progress, and economic growth, the authors conclude that

policymakers in Pakistan need to focus on developing the skills and competencies necessary for obtaining patents and fostering an entrepreneurial mindset, emphasizing the critical role of strong institutions in this process.



Figure 3. Number of organizations carrying out scientific research and development in the Republic of Belarus in the period 2020–2024, units

Source: compiled by the author based on data from the National Statistical Committee of the Republic of Belarus

In the Republic of Belarus, the National Intellectual Property Center of the Republic of Belarus operates, the activities of which are based on the Strategy of the Republic of Belarus in the Sphere of Intellectual Property until 2030. According to the Strategy, the main goals of state intellectual property policy are:

- in the medium term – building the potential of intellectual property as a key element of the national innovation system, enhancing its role in the development of high-tech and knowledge-intensive sectors of the national economy, the socio-cultural sphere, investment, and export activities;
- in the long term – comprehensively integrating the national intellectual property system into the state's socio-economic policy and enhancing the competitiveness of the national economy based on knowledge and innovation.

Considering the role of science and technology parks in scientific and technological progress, it is necessary to dwell on the study by Jiang and Mei (2016). The authors conduct an empirical study of the influence of the social capital of a science and technology intermediary on knowledge transfer using the example of the Science and Technology Park of Nanjing University. In examining the mechanism by which the social capital of a science and technology intermediary influences knowledge transfer, the authors conclude that network ties in the structural dimension of social capital of a science and technology intermediary are relatively close and act as the "center" of social capital connections within the network. The network is denser and more connected, creating a favorable environment for knowledge transfer. Network stability is highest in universities, better in research institutes and incubators, and lowest in enterprises. A study of the relationship between the social capital of a science and technology intermediary and knowledge transfer shows that social capital associated with the government can positively contribute to the opportunities and motivation for knowledge transfer, but has a weaker impact on the potential for

knowledge transfer. Social capital associated with the source of knowledge and corporations has a positive impact.

Science and technology parks (technoparks) play a key role in progress, serving as a link between science and industry. They accelerate the commercialization of innovations by providing researchers with the infrastructure for creating prototypes. Technology parks bring together startups, universities, and industrial enterprises, stimulating the growth of knowledge-intensive industries and the development of regional economies.

The key aspects of technology parks' role in scientific and technological progress can be summarized as follows:

- *Commercialization of scientific research*: Transforming the results of research and development (R&D) into finished commercial products.
- *Creation of innovative infrastructure*: Providing residents with access to modern laboratories, production facilities, offices, and shared-use centers.
- *Fostering startups*: Supporting small innovative enterprises in the early stages (including consulting, mentoring, and assistance in attracting investment).
- *Integrating science and the real sector*: Ensuring close collaboration between universities, research institutes, and manufacturing companies.
- *Economic growth and job creation*: Developing high-tech industries, which leads to increased competitiveness of the regional and national economies.

It should be noted that Belarus has 23 innovation infrastructure entities (16 science and technology parks and 5 technology transfer centers). While there was only one technology park in 2009, their number has steadily increased (Figure 4).

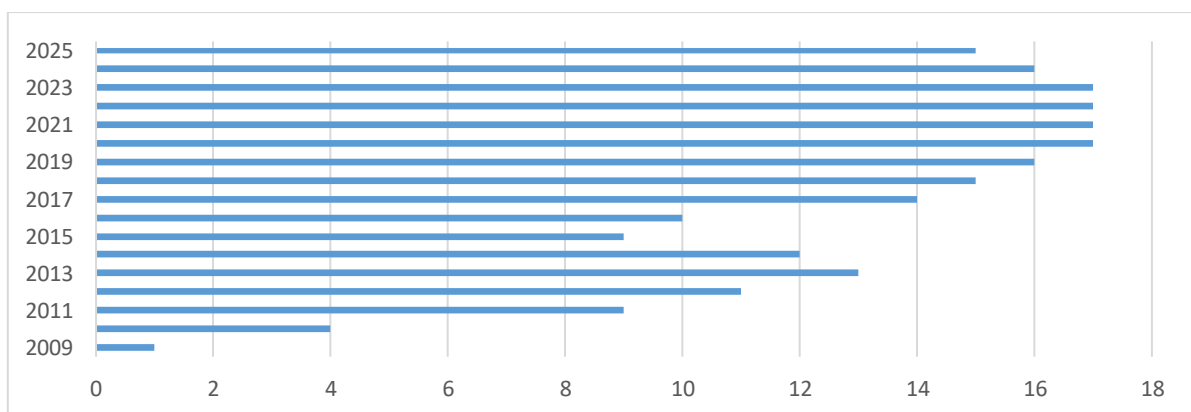


Figure 4. Development dynamics of science and technology parks in the Republic of Belarus in 2009-2025, units.

Source: compiled by the author based on data from the Belarusian Institute of System Analysis and Information Support for Science and Technology

The number of science and technology park residents is also steadily increasing. By the end of 2024, the number of residents reached 274, while the number of resident employees decreased to 928 (Figs. 5-6).

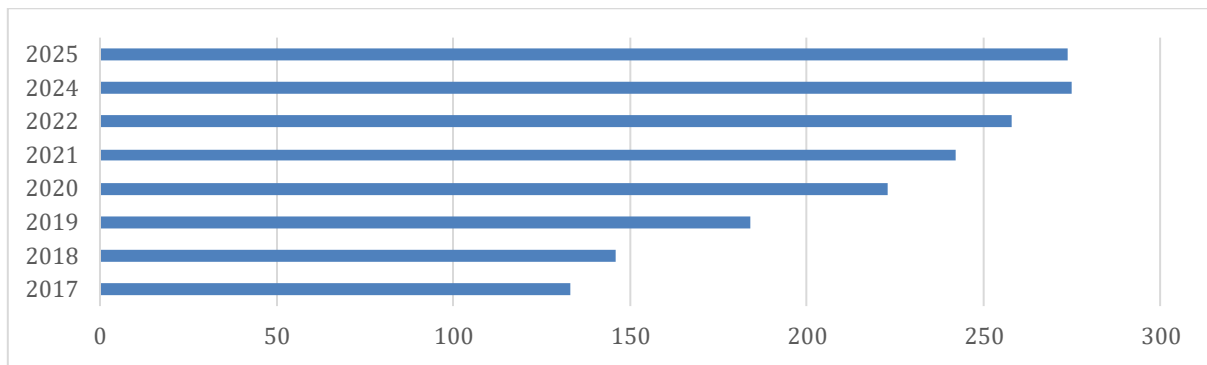


Figure 5. Number of residents of science and technology parks of the Republic of Belarus in the period 2017-2025, units

Source: compiled by the author based on data from the Belarusian Institute of System Analysis and Information Support for Science and Technology

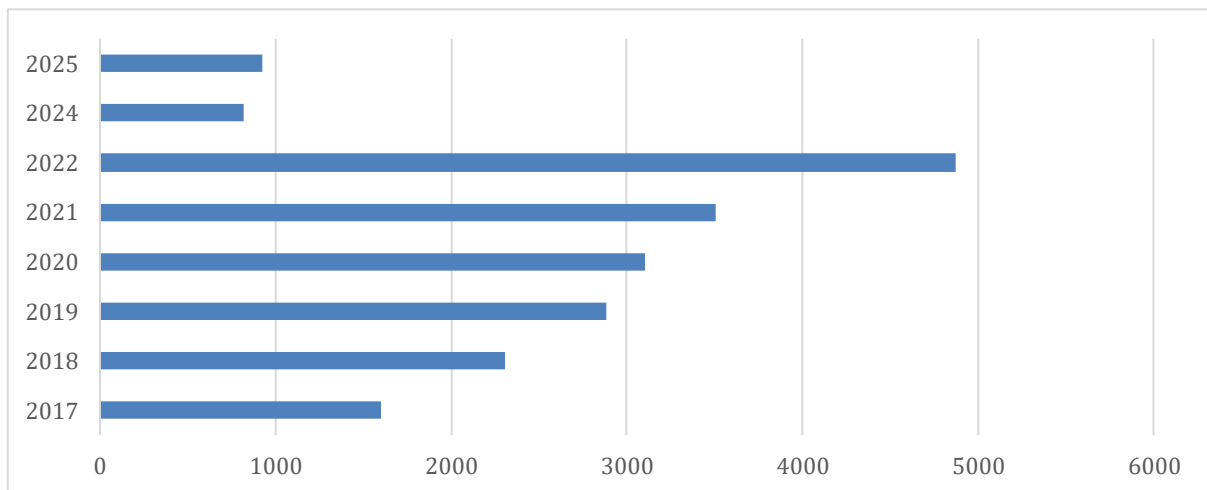


Figure 6. Number of employees of residents of science and technology parks of the Republic of Belarus in the period 2017–2025, units

Source: compiled by the author based on data from the Belarusian Institute of System Analysis and Information Support for Science and Technology

Various competitions and startup events are held annually in the country, including «100 Ideas for Belarus», «Greatstartup» startup competition (Minsk City Technopark LLC, etc.), the «ENCOBI» business idea competition (InCata Scientific and Technological Park LLC, etc.), hackathons, and competitions such as «Startup Bootcamp BSU», «Minskaya Smena», and other events. A Startup Center was established within the Secretariat of the Supervisory Board of the High-Tech Park (HTP) (2024), which has signed agreements with virtually all universities for startup development as part of the «University 3.0» concept in Belarus.

In Belarus, loans for innovation and modernization are provided by the Development Bank, Belarusbank, and other banks, offering rates of approximately 0.5 times the National Bank's refinancing rate. Preferential financing for up to 7-15 years is available for small and medium-sized businesses (SMEs) and investment projects, including the acquisition of equipment, technology, and the creation of high-tech production facilities.

Main sources of innovation financing:

- 1) Development Bank of the Republic of Belarus (DBRB): Programs for SMEs offering financing for the implementation of innovations, the acquisition of equipment, and the creation of new production facilities.
- 2) Belarusbank – «Micro-Business Innovations» is a specialized loan product designed to support small businesses, including technology park residents. The loan is issued for a term of up to 7 years in an amount of up to 15,000 basic units to finance investment projects, the creation of non-current assets, and the acquisition of equipment.

Main terms of the «Micro-Business Innovations» product:

- Purpose: creation of non-current assets, acquisition of equipment, intangible assets, and increasing working capital as part of an investment project.
 - Target audience: technology park residents, small businesses.
 - Loan amount: up to 15,000 basic units.
 - Loan term: up to 7 years.
 - Collateral: pledge of the acquired property, as well as a surety from individuals (usually up to 50% of the amount).
 - Benefits: Possibility of deferring principal repayment.
- 3) Industry funds and the Belarusian Innovation Fund: Support for scientific and technical projects, modernization of production facilities.

The Belarusian Innovation Fund (BelInfond) provides financial support for the development of scientific and technical, high-tech, and venture projects, ensuring their commercialization. The fund's main products are targeted loans, commercialization grants, financing of research and development work, and expert evaluation of innovative ideas.

The BelInfond's main areas of support:

- *Financing of innovative projects*: Providing repayable funds for the creation of new production facilities, the implementation of new technologies, and the production of high-tech products. Venture Financing: Investing in risky projects that are in the early stages but have high growth potential.
- *Commercialization of Scientific and Technical Developments*: Providing grants for the implementation of research results in the real economy.
- *«Strong Regions» Product*: A financial instrument aimed at supporting regional investment initiatives and developing local infrastructure.
- *Expertise and Support*: Belinfond acts as a government customer, drafting tripartite agreements and overseeing the use of funds and project implementation.

The fund works with projects within the framework of state, industry, and regional scientific and technical programs.

- 4) Partner Banks (Priorbank, Belgazprombank): Specialized loan products for modernization and the purchase of fixed assets.

For example, Belgazprombank actively supports innovative projects, offering loans to businesses focused on import substitution, high technology, and green initiatives. Financing

is available in Belarusian rubles (from 6.38% under partnership terms) and foreign currency, with long-term lending options (up to 5 years).

Key areas of innovative loans:

- Technology and Innovation: Support for companies developing new technologies and import-substituting products.
- Green Loans: Financing energy efficiency and sustainable energy projects with reduced interest rates.
- Investment Loans: Financing for equipment acquisition, production modernization, and the implementation of new solutions.
- Financing through the Development Bank: Special programs for small and medium-sized businesses, including those for innovation, with rates starting from 6.38% BYN.

Priorbank offers specialized loans for innovative businesses, including investment programs of up to 500,000 BYN (up to 60 months) and support programs from the Development Bank. Rates for these special programs range from 6.25% to 10.5%. Financing options are also available for modernization and the purchase of eco-friendly products.

Key credit products for innovation and development:

- Investment loans: Designed for modernization and development. Amount: up to 500,000 BYN, covering up to 80% of the project cost, term: up to 60 months, often without the need for providing a feasibility study.
- Special programs of the Development Bank: Support for manufacturing, environmental projects, and startups. Rates range from 6.25% to 10.75%, terms of up to 60 months. Financing for ongoing operations: Up to 500,000 BYN for up to 18 months (rate of ~12.91%) for working capital, which can be used for innovation.
- Green loans: Programs for the purchase of environmentally friendly goods and equipment.

An analysis of loan products revealed the Development Bank of the Republic of Belarus, which offers the «Technological Self-Sufficiency» loan (Tab. 4).

When examining the role of the state in scientific and technological progress, Xin's (2024) article on institutional openness, technological progress, and national economic growth is worth mentioning. Using data from the Global Innovation Index for 2013–2022, the author examines the impact of China's «Special Plan for Cooperation in Scientific and Technological Innovation within the Framework of the Belt and Road Initiative» (SPCI) on the per capita gross domestic product (GDP) of countries along the route. The results show that the SPCI policy increases GDP by continuously stimulating technological progress. For countries with low human capital and low technological capabilities, the policy's impact is more pronounced.

Table 4. Key Focus Areas of the Technological Self-Sufficiency Credit Program of the Development Bank of the Republic of Belarus

Financing Options	Terms	Requirements for Investment Projects Eligible for Lending
Import substitution, localization and local raw materials	Loan currency – Belarusian ruble; loan term – the payback period of the investment project, but no more than 15 years; loan amount – no more than 100 million rubles; interest rate – no more than 7 percent per annum from the date of the loan agreement until December 31 of the sixth year following the year of the loan agreement; no more than the refinancing rate increased by 3 percentage points – in subsequent years.	a) Import substitution – production of high-tech import-substituting products for final consumption b) Localization – increasing the level of localization of in-house production and/or production of products for the business entity to which products are shipped under the project, and/or production of products corresponding to the codes of the General State Classifier of the Republic of Belarus OKRB 007–2012 «Classifier of Products by Type of Economic Activity», specified in the Appendix to Resolution No. 80 of the Government of the Republic of Belarus dated February 17, 2022 c) Local raw materials and materials – production of furniture, finished products made from flax with in-depth processing of domestic raw materials and materials (own and purchased – wood, fiberboard, flax) and other types of products from local raw materials as instructed by the Government
Promising industrial directions	Loan currency – Belarusian ruble; loan term – the payback period of the investment project, but no more than 15 years; loan amount – no more than 100 million rubles (for items "a" and "b" of column 3); loan amount – no more than 200 million rubles (for item "c" of column 3); interest rate – no more than 6 percent per annum from the date of execution of the loan agreement until December 31 of the sixth year following the year of execution of the loan agreement; no more than the refinancing rate increased by 3 percentage points – in subsequent years.	a) organizing the production or implementation of robotic systems (industrial robots); b) organizing the production of unmanned systems (air and ground); c) organizing the production of biotechnology-based products)
Industrial mortgage projects	Loan currency – Belarusian ruble; loan term – the payback period of the investment project, but no more than 15 years; interest rate – no more than 7 percent per annum from the date of the loan agreement until December 31 of the sixth year following the year of the loan agreement; no more than the refinancing rate increased by 3 percentage points – in subsequent years.	These projects provide for the construction of industrial buildings for subsequent lease, including with the right of subsequent purchase, to small and medium-sized businesses. are implemented by: – organizations authorized by local authorities; – business entities that are residents of free (special) economic zones; – organizations acting as management companies (development companies) of industrial parks and special economic zones; – technology parks.

Source: compiled by the author based on data from the Development Bank of the Republic of Belarus

State concepts of scientific and technological progress (STP) aim to improve economic efficiency through innovation, automation, and the creation of knowledge-intensive industries. Key tools include the Comprehensive Scientific and Technical Progress Forecast (CSTP), state programs for innovative development, and the identification of priority areas (AI, biotechnology, new materials) to achieve technological sovereignty.

Key aspects of the state concepts of the scientific and technical progress of Belarus:

- *Comprehensive Forecast (CSTP)*: Developed for the long term (e.g., until 2040–2045) to assess global trends and identify promising technologies.
- *Priority areas*: The State Committee on Science and Technology (SCST) compiles a list of key industries that contribute the most to GDP.
- *Implementation*: Conducted through state scientific and technical programs (SSTP) and full-cycle innovation projects (R&D - OK(T)R - production).
- *Goals*: Technological modernization, growth in high-tech exports, and ensuring national security.

Main forms of state-stimulated scientific and technical progress:

- *Evolutionary*: Modernization of current production based on existing scientific knowledge.
- *Revolutionary*: Implementation of fundamentally new, breakthrough technologies (AI, nuclear energy, robotics).

The state stimulates scientific and technological progress (STP) through support for technological innovation, the development of fundamental science, and the digitalization and automation of production. The main forms include direct funding (government procurement, grants) and indirect methods (tax incentives, creation of technology parks) aimed at implementing new technologies and creating high-tech infrastructure.

The main forms of state stimulation of STP are:

- *Technological innovation*: Financing breakthrough research and development (R&D) aimed at creating fundamentally new equipment and technologies.
- *Technology dissemination*: The state promotes the commercialization of scientific knowledge, technology transfer, and its implementation in the real sector of the economy.
- *Infrastructure creation*: Formation of technology parks, innovation centers, and clusters that provide links between science and production.
- *Government procurement and grants*: Direct funding of priority areas (e.g., AI, biotechnology, new materials).
- *Tax and financial incentives*: Reducing the tax burden on companies investing in innovation.
- *Human capital development*: Supporting the education system and training personnel for high-tech industries.

In the Republic of Belarus, the All-Belarusian People's Assembly approved the Program for Social and Economic Development of the Republic of Belarus for 2026–2030. This

document notes that a number of systemic imbalances persist in the Republic of Belarus, including a low technological structure. In the manufacturing industry, the share of low- and medium-tech industries accounts for 62.8 percent of added value, while high-tech industries account for only 7.8 percent. A chronically low level of implementation of research and development results and patents, a weak science-production-education interaction mechanism, and a shortage of scientific personnel are noted.

This Program identifies several development priorities for the next five years, including increasing competitiveness, accelerating technological development, and digital transformation. The country has also approved the State Program for Innovative Development for 2026-2030, which, in particular, outlines the concentration of state support on the development, modernization, and implementation of critical technologies (goods) in order to overcome dependence on the import of such technologies (goods). The state program was developed taking into account proposals from scientists and experts for improving the scientific sphere, as well as the results of its implementation in 2021-2025.

More than 50 innovative projects have been successfully implemented, creating science-intensive and high-tech products worth Br17.4 billion, of which Br6.1 billion was exported. In the new five-year plan, public and private organizations will implement innovative projects to create new production facilities within the program's framework, aligned with the priority areas of scientific, technical, and innovative activity for 2026-2030. This will enable the successful development of domestic scientific and technological potential, increase the production of innovative products created using advanced domestic technologies, substitute critical imports, and strengthen the country's technological sovereignty.

As a result of the program's implementation, by 2030, the share of innovation-intensive organizations is expected to increase to 45%, and the volume of exports of science-intensive and high-tech products will reach €2.5 billion, including at least €550 million from technology park residents.

All of the above demonstrates the Republic of Belarus's desire to achieve technological sovereignty by leveraging the country's scientific, scientific-technical, and technological potential. The primary driver is its scientific potential, which is experiencing certain challenges, including an aging research workforce, access to funding, and isolation from global scientific thought due to sanctions.

5. Conclusions

We agree with Belyakov and Kochemaskin (2014) that ensuring the scientific and technological development of the economy is a complex task built on the interconnected development of all its component elements.

For the Republic of Belarus, the conclusion of Jiang and Mei (2016) that a scientific and technological intermediary can shape a compromising culture within a network, while moderate cultural diversity facilitates knowledge transfer, is of particular importance.

Based on the above, the following conclusions can be drawn. While considering the positive impact of scientific and technological progress, it is also necessary to consider the negative consequences. The Republic of Belarus is confidently on the path of scientific and technological progress.

The Republic of Belarus has not yet experienced the negative impact of scientific and technological progress. The only drawback is the isolation from scientific and technological developments due to sanctions. However, this encourages efforts to gain technological sovereignty. Therefore, it can be assumed that sanctions, for example, have a positive impact on scientific and technological progress in Belarus.

To achieve technological sovereignty, it is necessary to activate the innovation, start-up, and entrepreneurial ecosystems in Belarus.

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ECONOMIC RESILIENCE AND SUSTAINABLE DEVELOPMENT OF SPORT IN THE CONTEXT OF GLOBAL ECONOMIC TRANSFORMATIONS

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Abstract. *Modern sports face major economic challenges due to financial crises, climate change, digitalization, and the effects of the COVID-19 pandemic. These transformations have forced sports clubs and organizations to rethink their economic models to ensure sustainability and financial resilience. In this context, adopting efficient economic strategies is essential for maintaining balance and long-term development. This study analyzes the main strategies and key factors that contribute to economic sustainability in sports. These include diversifying funding sources, implementing digital technologies to optimize costs, and promoting public-private partnerships. Additionally, public policies play a crucial role in supporting sports infrastructure and ensuring economic protection mechanisms during crises. Based on international literature and best practice examples, the study highlights the importance of an integrated approach to strengthening financial resilience in sports. Increasing sustainable investments, fostering innovation, and enhancing adaptability are key factors for the success of sports organizations in the context of global transformations.*

Keywords. *economic sustainability, sport, financial resilience, digitalization, public policies.*

Classification JEL: O15.

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1. Introduction

In recent decades, sport has evolved from a purely cultural and social phenomenon into a complex economic sector with a significant contribution to the global economy (Andreff, 2019). The sports industry generates substantial revenues through events, sponsorships, broadcasting rights, and sports tourism, becoming interconnected with numerous other industries (Smith & Stewart, 2021). In this context, the concept of economic sustainability in sport has gained particular importance, especially in light of global economic challenges.

The financial crises of recent years, including the 2008 global economic recession and the COVID-19 pandemic, have had a significant impact on the sports sector (Deloitte, 2021). Sports clubs and organizations have been compelled to reconsider their financial strategies in order to survive during periods of instability. For instance, studies by Késenne (2020) highlight that the pandemic led to dramatic declines in sports clubs' revenues due to the absence of spectators, thereby reducing income from ticket sales and merchandising. Moreover, the suspension of competitions and restrictive measures generated considerable economic losses for leagues and sports federations (Ratten, 2020).

Beyond economic crises, sport is also confronted with challenges related to digitalization and climate change (Trendafilova et al., 2013). Digitalization has produced major transformations in the way sporting events are organized and monetized, requiring clubs to invest in technological infrastructure and digital platforms to maintain revenue streams (Parganas & Anagnostopoulos, 2022). Simultaneously, climate change affects outdoor sports, prompting international federations to adopt sustainable policies aimed at reducing the carbon footprint of sporting events (Orr & Inoue, 2019).

Another essential aspect is the role of public policies in ensuring the economic sustainability of sport (Houlihan & Green, 2011). Governments and international bodies develop financial support strategies and regulatory frameworks aimed at maintaining the economic stability of clubs and federations. For example, the European Union has implemented measures to support sports infrastructure and promote a fair distribution of revenues between large and small clubs (European Commission, 2021).

Economic sustainability and resilience in sport are essential factors for maintaining financial balance and ensuring long-term development. Recent studies emphasize the need for effective adaptation policies, given the multiple challenges currently facing the sports sector. An analysis of the economic strategies employed by sports organizations can provide viable solutions for achieving durable financial stability.

Therefore, it is essential for sports organizations to adopt innovative business models that not only respond to immediate economic challenges but are also flexible and prepared to adapt to long-term changes. The implementation of sustainable strategies, such as investments in environmentally friendly infrastructure, diversification of revenue sources, and the promotion of transparent and responsible financial management, represents key steps in ensuring sustainable economic development in sport. Furthermore, the integration of emerging technologies, such as artificial intelligence and data analytics, can significantly enhance operational efficiency and identify growth opportunities in global markets (Parganas & Anagnostopoulos, 2022).

Another important factor in maintaining the economic sustainability of sport is the involvement of fans and the broader community. Sport has evolved from a simple competition into a global experience, and fan loyalty and engagement are critical factors in building a robust economic ecosystem. Sports clubs and organizations must better understand fan preferences and respond by offering personalized experiences and creating digital platforms that facilitate continuous and mutually beneficial interactions. This type of engagement can lead to increased revenues from sponsorships, broadcasting rights, and merchandising, while also fostering a loyal long-term supporter base (Houlihan & Green, 2011).

Economic sustainability in sport is a multidimensional concept that requires an integrated approach. Economic and environmental challenges, as well as the rapid impact of technology on the industry, necessitate that sports organizations adopt innovative solutions that not only ensure survival in times of crisis but also enable long-term development. Research in sports economics emphasizes the importance of close collaboration among all stakeholders - including governments, international organizations, clubs, sponsors, and fans - in order to build an economically sustainable and resilient sports sector.

2. Literature Review

The concept of economic sustainability in sport has gained increasing scholarly attention over the past two decades, particularly in the context of globalization, financial instability, and rapid technological advancement. The transformation of sport into a major economic sector has generated complex financial structures, diversified revenue streams, and increased exposure to systemic risks (Andreff, 2019).

Sports economics literature emphasizes that professional sport operates within a hybrid model that combines market-driven mechanisms with regulatory and institutional frameworks (Smith & Stewart, 2021). Unlike traditional industries, sport is characterized by competitive balance requirements, revenue-sharing systems, and governance mechanisms that influence financial performance and long-term sustainability. These structural particularities make the sports sector especially sensitive to macroeconomic shocks.

The global financial crisis of 2008 marked a turning point in the financial management of sports organizations. Studies indicate that reduced public funding, declining sponsorship investments, and lower consumer spending significantly affected clubs and federations (Késenne, 2020). More recently, the COVID-19 pandemic exposed the vulnerability of revenue models heavily dependent on matchday income and live spectators. Deloitte (2021) reports substantial revenue losses across major European leagues, highlighting the urgent need for diversified and resilient financial strategies.

In response to these disruptions, researchers have increasingly focused on resilience as a key analytical framework. Financial resilience in sport refers to the capacity of organizations to absorb shocks, adapt to changing environments, and maintain operational continuity (Ratten, 2020). Sustainable business models, strategic financial planning, and effective governance structures are identified as critical determinants of long-term viability.

Digital transformation represents another major theme in contemporary literature. The expansion of digital broadcasting, streaming platforms, and data analytics has reshaped revenue generation and fan engagement strategies (Parganas & Anagnostopoulos, 2022). Digital ecosystems enable sports organizations to diversify income sources, enhance global reach, and optimize performance management. However, they also require significant investment and organizational adaptability.

Environmental sustainability has also emerged as an integral component of economic sustainability. Climate change increasingly affects sporting events, particularly outdoor competitions, while stakeholders demand environmentally responsible practices (Orr & Inoue, 2019). The integration of green infrastructure, carbon reduction policies, and sustainable event management contributes not only to environmental protection but also to long-term economic stability and reputational capital.

Public policy and governance structures further influence the economic sustainability of sport. Houlihan and Green (2011) underline the importance of regulatory frameworks, state support mechanisms, and international coordination in maintaining sectoral stability. The European Commission (2021), for example, promotes financial transparency, fair competition, and balanced revenue distribution to strengthen resilience within the European sports model (European Commission, 2021, Houlihan & Green, 2011).

Overall, the literature suggests that economic sustainability in sport is multidimensional, encompassing financial diversification, digital innovation, environmental responsibility, and institutional governance. While significant progress has been made in understanding individual components, there remains a need for integrated approaches that address systemic global transformations and their long-term implications for the sports sector.

3. Methodology

Research Design. This study is based on a qualitative, exploratory, and comparative research design aimed at examining the mechanisms that support economic sustainability and financial resilience in sport within the context of global systemic transformations. The research adopts an interdisciplinary approach, integrating perspectives from sports economics, public policy, and strategic management.

Research Methods. To achieve the research objectives, the following methods were employed:

1. **Systematic literature review** - A structured review of international scientific publications was conducted to identify theoretical models, conceptual approaches, and empirical findings related to economic sustainability and resilience in sport. The analysis focused on peer-reviewed articles, institutional reports, and policy documents.
2. **Legislative and public policy analysis** - National and international regulatory frameworks influencing the sports economy were examined using comparative legal analysis. This method enabled the identification of policy instruments that contribute to financial stability, governance efficiency, and equitable resource distribution.
3. **Comparative case study analysis** - Ten international projects and initiatives that successfully implemented economic sustainability models in sport were analyzed. The case study method facilitated the identification of best practices, innovation patterns, and resilience strategies applicable across different institutional contexts.

Research Organization. The research was conducted over a 12-month period and involved:

- The review and critical analysis of more than 50 international scientific studies in the field of sports economics and sustainability;
- A comparative examination of legislative frameworks and public policies in the European Union, the United States, and selected Asian countries;
- An in-depth evaluation of 10 international projects that implemented financial sustainability and resilience mechanisms in sports organizations.

Data were synthesized through qualitative comparative analysis, allowing for the identification of common patterns, strategic approaches, and structural determinants of economic resilience in sport.

4. Results and Discussion

In order for our research to be further developed, we analyzed the economic crises that had a significant impact on global sport, affecting club financing, infrastructure, and investments. Subsequently, we classified them into several aspects, as follows:

Aspect No. 1. The impact of economic crises on sport. The COVID-19 pandemic represented one of the greatest recent challenges, generating massive losses in the sports industry.

The COVID-19 pandemic and its effects on sports clubs' revenues. According to a report conducted by Deloitte (2021), the COVID-19 pandemic reduced the revenues of European sports clubs by approximately 30%. In addition, 20% of small organizations were forced to suspend their activity due to a lack of financial resources. These data are supported by the 2021 FIFA report, which shows that the football industry lost approximately \$14 billion due to the pandemic (Deloitte, 2021).

Table 1. Impact of the COVID-19 Pandemic on European Sports Clubs' Revenues

Indicator	Before the pandemic (2019)	After the pandemic (2020–2021)
European clubs' revenues	€28.9 billion	€20.3 billion (–30%)
Number of suspended clubs	–	+20%
Matchday revenues	€4.6 billion	€1.7 billion (–63%)

Source: Authors' elaboration based on Deloitte (2021) and FIFA data cited in the study.

Aspect No. 2. The effects of economic recessions on sport. Studies conducted by Késenne (2020) show that economic recessions led to reductions in sports clubs' budgets, decreases in players' salaries, and even the bankruptcy of certain sports organizations. For example, following the 2008 financial crisis, several clubs from lower European leagues declared bankruptcy.

Successful Models of Economic Sustainability. In order to address these challenges, some countries have implemented effective economic sustainability strategies in sport.

Germany. Public Funding Policies

Germany adopted a strategy to financially support football clubs through public policies. According to the Bundesministerium des Innern und für Heimat (2022), the German government allocated additional funds to Bundesliga clubs in order to reduce dependence on sponsorship revenues (Bundesministerium des Innern und für Heimat, 2022). Example. The “50+1 Rule” model ensures that the majority of club shares are owned by members, thereby protecting economic stability.

United States. Public-Private Partnerships

The United States promotes public-private partnerships for investment in sports infrastructure. Studies by Smith & Stewart (2021) show that this strategy has ensured economic balance for many professional leagues, such as the National Basketball Association and the National Football League.

Japan. Digitalization and Revenue Optimization

Japan has invested heavily in the digitalization of sports management. According to the Ministry of Education, Culture, Sports, Science and Technology of Japan (2023), the use of artificial intelligence and big data analytics has increased the financial efficiency of clubs (Ministry of Education, Culture, Sports, Science and Technology of Japan, 2023).

Aspect No. 3. The role of technology in increasing economic resilience. Integration of Digital Technologies. The adoption of emerging technologies has become a key factor in the

economic resilience of sport. According to the PwC report (2022), technologies such as blockchain, NFTs, and virtual reality have increased sports clubs' revenues by 15% in recent years (PwC, 2022).

Table 2. Economic Impact of Digital Technologies in Sports Organizations

Technology	Economic Impact
Blockchain	10% revenue increase through digital ticketing
NFTs	+5% revenue through digital collections
Virtual reality	Increased fan engagement and online monetization

Source. Authors' elaboration based on PwC (2022)

Practical-methodological recommendations

- Diversification of funding sources through the integration of digital technologies and European funds.
- Creation of favorable fiscal policies for sport through government subsidies and public-private partnerships.
- Development of economic risk management mechanisms for sports organizations.
- Implementation of financial education strategies for sports managers.
- Investment in education and training for the implementation of new technologies – Sports clubs and organizations must invest in staff training to adopt and utilize emerging technologies such as blockchain, NFTs, and virtual reality, which can contribute to revenue growth and increased economic efficiency.
- Creation of an integrated resource management system - Implementation of digital platforms to help clubs manage financial and human resources more efficiently, reducing operational costs and maximizing revenues.
- Promotion of public-private partnerships for infrastructure - Encouraging investments in sports infrastructure through cooperation between the public and private sectors, contributing to the development of high-quality facilities and the generation of new financial flows.
- Development of climate adaptation policies - Adoption of ecological and sustainable measures to minimize the negative impact of climate change on outdoor sports, such as implementing technologies that reduce carbon emissions and natural resource consumption.
- Diversification of revenue models - Sports clubs must explore new sources of revenue, including increasing fan participation in virtual events, selling digital products and services, and developing subscription models for access to events and exclusive content.

5. Conclusions

Global sport is currently experiencing profound economic transformations, driven by financial crises, accelerated digitalization, and evolving consumer behavior. Ensuring sustainable economic equilibrium in this context necessitates the adoption of robust strategies for financial sustainability and organizational resilience.

A key approach to addressing these challenges lies in the comprehensive digitalization of the sports industry. Emerging technologies-including online streaming platforms, augmented and virtual reality, and artificial intelligence-offer significant potential for creating new revenue streams, enhancing fan engagement, and increasing accessibility for athletes and spectators alike. Concurrently, strategically structured public-private partnerships have become indispensable for mobilizing financial resources and developing sports infrastructure in a sustainable and efficient manner.

Furthermore, adaptive and flexible economic policies are critical to enabling rapid responses to market fluctuations. Interventions such as restructuring funding models, optimizing resource allocation, and diversifying revenue sources can substantially mitigate the exposure of sports organizations to global economic instability.

In conclusion, the future trajectory of global sport will depend on stakeholders' capacity to implement innovative, technology-driven strategies while fostering resilient economic frameworks. By embracing a sustainable and adaptive model, the sports sector can not only safeguard its continuity but also promote long-term growth and development in the face of contemporary global challenges.

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EFFECTIVE COLLABORATION AS A DEVELOPMENT TREND AND APPROACH FOR CREATING INNOVATIONS

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Abstract: *In the era of globalization, rapid technological advancement, and increasing interconnectedness among economic entities, effective cooperation has become essential for fostering development, innovation, and organizational success. The growing complexity of the economic landscape and market dynamics requires a move away from isolated organizational actions toward broader collaboration among diverse actors within the economic system. This study explores effective collaboration as both a current trend in entrepreneurial growth and a strategic tool for generating and implementing ideas. It examines the main types of interactions between companies and the factors that either promote or hinder the formation of joint ventures. Special focus is given to the role of small and medium-sized organizations that work with larger companies and institutions at the regional, national, and international levels. The findings highlight the significance of effective collaboration in sharing information, merging resources, and boosting the potential for organizational innovation – all of which support competitiveness and long-term growth.*

Keywords: *collaboration, development, effective collaboration, entrepreneurship, innovation.*

Classification JEL: O20, O30, O31.

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1. Introduction

Globalization, rapidly changing markets, an uncertain economic and political climate, the dynamism of business processes, and various other factors all continuously influence the growth of modern entrepreneurship. As a result, it is becoming increasingly challenging for individual businesses to reach their goals and succeed on their own. Therefore, they often seek collaboration with other organizations, using various forms and levels of cooperation tailored to their specific circumstances. These approaches are mostly related to SMEs working together, but they can also be observed in interactions between SMEs and larger firms at regional, national, and supranational levels.

2. Literature Review

According to Jarillo (1988), forming strategic partnerships is a key strategy for companies seeking sustainable growth amid rising competition. In this context, competition catalyzes collaboration among entrepreneurs, encouraging the formation of business alliances. Busygin (1997) highlights that entrepreneurs focus on effective interaction models to maximize profits and improve business performance. Additionally, partnerships are often formed to navigate the complexity, uncertainty, and rapid change in the corporate environment (Leogrande et al., 2023), as well as to distribute risks given limited resources. Pressure from large corporations on small and medium-sized enterprises (SMEs) also increases the need for collaboration (Audretsch et al., 2023).

Recent studies have explored the role of innovation networks and ecosystems. Zygmunt and Dvouletý (2024) found that an innovative organizational culture encourages

companies to pursue external partnerships and collaborative research, thereby increasing the potential to develop new products and technologies. The authors emphasize that collaboration with universities, scientific institutes, and other firms promotes knowledge exchange and accelerates innovation.

In a similar vein, Pepe et al. (2024) analyzed worldwide scientific collaboration networks and their impact on countries' innovation potential. They demonstrate that nations with more developed collaboration networks between scientific institutions and enterprises rank higher in global innovation indices.

Audretsch et al. (2023) make substantial contributions to the study of enterprise collaboration. According to their findings, various collaboration tactics, such as collaborations with scientific institutions, suppliers, and other firms, improve the innovative performance of small and medium-sized businesses. The authors conclude that collaboration enables businesses to combine diverse knowledge and technology resources, hastening the development of new products and services.

Similar findings are seen in the study by Xin et al. (2023), who investigate the concept of "collaborative advantage" in supply chain innovation. The authors underline that strategic entrepreneurship and collaboration among different firms have a synergistic effect that promotes long-term innovation and increases enterprise competitiveness.

An analysis of the factors influencing collaboration between SMEs in Europe was conducted by Leogrande et al. (2023). Their results show that collaboration is strongly influenced by access to finance, technological infrastructure, and the level of development of innovation systems in the respective countries.

A more recent study investigates collaboration via the lenses of open innovation and digital transformation. For example, Shi and Xiao (2024) investigate the significance of cross-sector innovation networks and discover that the degree of connectedness among network participants has a considerable impact on the effectiveness of joint innovation initiatives.

Contemporary research emphasizes the role of corporate culture and technical readiness in achieving successful collaboration. According to a study of small and medium-sized enterprises, the efficiency of joint innovation is determined not only by the frequency of contacts between organizations but also by firms' internal capabilities, such as adaptability, technological preparedness, and a collaborative culture Pepe et al. (2024).

Based on this, it is possible to conclude that contemporary literature views cooperation not just as an organizational structure, but also as an important strategic tool for encouraging innovation and long-term economic development.

The prerequisites for the formation of partnerships can be analyzed in two ways: from the perspective of macroeconomic trends and from that of technological progress. In a broader socioeconomic context, global societal shifts influence the creation of partnerships. Among the primary elements that influence this process are globalization and internationalization, ICT advancements, environmental challenges, infrastructure growth, cultural homogenization, workforce evolution, and regulatory harmonization (Leogrande et al., 2023), (Shi and Xiao, 2024).

Global processes impact corporate collaboration by removing trade barriers, enabling the free movement of capital, ideas, and labor, and expanding opportunities for international

partnerships. The deteriorating global economic situation leads to a decline in investment and an increase in risk, prompting firms to form strategic alliances to enhance sustainability, reduce costs, and gain access to new resources.

Technological advancements are critical to the growth of business cooperatives. The advancement of information and communication technology, digitalization, artificial intelligence, and automation opens new avenues for cross-sectoral collaboration, notably in scientific research, marketing, and manufacturing processes. These technological developments not only make business relationships more successful but also encourage the development of novel goods, services, and business models, enhancing the worldwide competitiveness of participating firms.

As a result, strategic alliances not only help overcome hurdles to entrepreneurial activity but also catalyze innovation, leading to long-term economic growth and greater efficiency across a variety of industrial sectors. We might infer that the development of cooperation is always a complex mixture of incentives and motives that drive entrepreneurs to form partnerships. These motives can be classified into four categories:

1. Organizational – training needs, skill acquisition, competency building, organizational restructuring, delivery improvement, market complementarity, and legitimacy.
2. Economic – reducing and sharing costs and risks; pooling of resources; improving productivity and market demand; economies of scale; joint specialization, etc.
3. Strategic – reducing uncertainty; better adaptability to the environment; increasing profits; obtaining new business opportunities; production of new goods and services; access to technologies, etc.
4. Political – overcoming legal and regulatory barriers; development of technical standards; strengthening the influence of the enterprise; better positions, etc.

3. Methodology

The current study aims to examine the role of successful collaboration in promoting innovation and business development. To achieve this, a set of scientific methods was used, enabling the investigation of both the theoretical and practical aspects of organizational cooperation.

The study uses a qualitative and analytical approach, combining a review of the scientific literature with a comparative analysis of current practices and policies in innovation cooperation. This method highlights the key elements that promote partnerships among businesses, research institutions, and other participants in innovation ecosystems.

The study used secondary data from global papers and statistical sources, along with analyses and indices of corporate innovation and collaboration. This allows an unbiased assessment of how partnerships contribute to innovation development.

The study has several key stages:

1. Identifying the key theoretical principles connected to cooperation and creativity.
2. Review and analysis of scientific literature, including recent studies on innovation networks and partnerships.

3. The primary elements determining cooperation's efficacy have been systematically organized.
4. An examination of the practical aspects of collaboration, such as its benefits, hazards, and limitations.
5. Conclusions on the function of successful collaboration as a mechanism for generating innovation.

The study primarily relies on secondary data and scientific literature, which limits the ability to verify some findings empirically. However, including a wide range of scientific sources and reports increases the overall reliability of the results.

4. Results and Discussion

Benefits of effective collaboration

According to the European Commission (2024), public-private partnerships are a key factor and method for driving innovation in Europe. The report indicates that regions with strong partnerships and innovation strategies are more successful in boosting economic growth through innovation.

Enterprises form various alliances to not only optimize resource use but also to build a foundation for quicker adaptation to the rapidly changing economic environment. Sharing access to knowledge, technology, financial resources, and markets leads to the creation of new products, enhancements in manufacturing processes, and expanded commercial opportunities for participants. The way companies interact significantly influences global innovation. The collaborative use of material, financial, and scientific resources creates a synergistic effect that boosts competitiveness both nationally and internationally while also accelerating the adoption of new technologies. Business collaborations reduce costs and risks significantly and foster the development of innovative management and marketing strategies suited to the global market.

One of the most significant advantages of inter-enterprise alliances is the creation of innovative ecosystems that enable the exchange of knowledge and best practices. This not only reduces the time required for research and development but also lays the groundwork for a more effective entry into new markets. Pooling resources and exchanging technology and management expertise helps to establish innovation as an important tool for economic progress.

The European Innovation Scoreboard (2024) noted that some French locations stand out for projects (such as the Paris-Saclay cluster) that bring together universities, research institutions, and industry to drive innovation in fields such as artificial intelligence and biotechnology. Such collaborations facilitate knowledge transmission between academics and business. In areas such as Västsväri (Sweden) and Vilnius (Lithuania), there is a high level of collaboration between small- and medium-sized enterprises (SMEs) and research organizations, which boosts the competitiveness of the innovation ecosystem. For example, Vilnius draws foreign investment due to its innovative hubs and clusters. In places such as Prague (Czech Republic), international research partnerships are significantly higher than the EU average. This demonstrates the effectiveness of establishing networks for global scientific collaboration. The University of Leuven in Wallonia (Belgium) is working with Thales Air Systems to create revolutionary drone technologies, showcasing the practical application of academic-industry partnerships.

Problems and risks of effective cooperation

The problems and risks surrounding effective collaboration can be classified into two categories. The first group comprises characteristics that discourage entrepreneurs from forming alliances with other economic entities. One of the main issues derives from entrepreneurs' desire for independence, which causes concerns that cooperation will result in a loss of autonomy. Another key difficulty is striking a balance between competitiveness and collaboration, as distrust among economic actors frequently limits opportunities for successful engagement. Additional challenges include a lack of an entrepreneurial culture, a weak economic environment, political instability, frequent legislative changes, and minimal support from local and central governments. All these variables contribute to a system in which entrepreneurs prioritize survival over strategic relationships for growth (Xin et al., 2023).

The second group of problems arises within the framework of already established cooperative relations between entrepreneurs. The main issues are loss of autonomy, development difficulties stemming from reliance on partners, the risk of selecting the wrong partner, discrepancies between expected and actual results, declines in economic indicators, technological incompatibility, partnership termination, and unfavorable external conditions. These problems highlight the importance of rigorous study when forming entrepreneurial coalitions and developing risk-management strategies (Zygmunt and Dvouletý, 2024).

The European Innovation Scoreboard (2024) cites many significant issues regarding innovation partnerships:

1. Insufficient integration of academia and industry: The absence of strong links between colleges and industry impedes the transmission of knowledge and technology. Researchers in Andalusia and Střední Čechy rarely apply their scientific discoveries in practice.
2. Limited resources for SMEs: SMEs typically struggle to participate in partnerships due to a lack of financial and human resources. Less-developed regions, such as Małopolska and Közép-Dunántúl, lack large enterprises capable of driving innovation, while SMEs lack the necessary competence to implement ideas.
3. Lack of public support: Cooperation is hampered by a lack of financial incentives and a complex administrative structure. In Andalusia, for example, there is a mismatch between available state support and real-world company requirements. Similar issues exist in Calabria, where complicated administrative procedures stifle innovation attempts.
4. Limited collaborative culture: In some regions, the academic atmosphere is frequently not geared toward commercializing scientific achievements. This leads to lesser innovation, particularly in locations with underdeveloped research institutes and a shortage of trained workers.

These issues underscore the need for targeted policies to increase collaboration among the various actors in the innovation process, particularly through well-developed infrastructure and the facilitation of public-private partnerships.

5. Conclusions

Effective collaboration is emerging as a critical aspect in fostering innovation and ensuring the long-term success of modern businesses. In an environment of globalization, dynamic marketplaces, and rapid technological advancement, it is increasingly challenging for individual firms to possess all the resources, expertise, and capabilities required for effective development. As a result, many forms of collaboration – strategic alliances, enterprise partnerships, interactions between corporate and scientific institutions, and public-private partnerships – are becoming increasingly important.

The study shows that effective cooperation fosters the flow of knowledge, technology, and management techniques. Organizations can cut R&D costs, speed the deployment of innovative technologies, and boost national and worldwide competitiveness by combining resources and knowledge. In this framework, current innovation ecosystems are built on the collaboration of universities, research institutions, businesses, and government agencies.

Despite the great potential for collaboration to boost innovation, the investigation reveals that several constraints impede its growth. The key challenges include insufficient financial and human resources, poor innovative infrastructure, cumbersome administrative procedures, and a lack of a stimulating institutional environment. Furthermore, in some locations, there is an underdeveloped culture of collaboration between industry and scientific groups, making it difficult to market scientific findings.

In this context, the creation and implementation of tailored policies to encourage collaboration among participants in the innovation process are critical. This includes creating a favorable legislative framework, encouraging collaborative research initiatives, supporting innovation clusters and technology parks, and developing methods for knowledge and technology transfer.

In conclusion, successful collaboration is not only an important trend in the development of modern entrepreneurship but also a strategic tool for driving innovation and enhancing economic competitiveness. The establishment of long-term collaborative networks across businesses, scientific institutions, and the public sector will remain critical to accelerating innovation and achieving long-term economic growth.

Future studies can focus on empirically analyzing certain models of enterprise collaboration, as well as measuring the impact of various policies and tools to foster innovation and interaction between businesses and scientific organizations.

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EXCHANGE RATE VOLATILITY AND EXPORT PERFORMANCE IN SMALL OPEN ECONOMIES: IMPLICATIONS FOR MOLDOVA

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Abstract: Exchange rate volatility is widely recognized as a key determinant of trade performance, particularly in small open economies where external competitiveness is sensitive to currency fluctuations. Despite Moldova's high degree of openness and reliance on external markets, empirical research directly linking exchange rate volatility to its export performance remains limited. This paper synthesizes existing literature on Moldova's exchange rate environment, develops a theoretical and conceptual framework for understanding the volatility-export nexus, and proposes a rigorous methodological approach for future empirical analysis. The paper concludes by identifying critical research gaps and outlining a comprehensive empirical strategy for quantifying the impact of exchange rate volatility on Moldova's exports.

Keywords: Republic of Moldova, Real Effective Exchange Rate Volatility, GARCH, ARDL/NARDL, exports, PPML, trade policy.

Classification JEL: F10, F13, F14, F17.

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1. Introduction

Exchange rate dynamics play a key role in shaping the external competitiveness of small open economies. For countries like the case of Moldova – characterized by a narrow export base, high import dependence, and exposure to external shocks – exchange rate volatility can significantly influence trade flows, investment decisions, and macroeconomic stability. While global literature provides extensive evidence on the relationship between exchange rate volatility and trade, Moldova-specific empirical studies remain scarce.

This paper addresses this gap by synthesizing existing research on Moldova's exchange rate environment, developing a theoretical framework for understanding the volatility - export relationship, and proposing a methodological strategy for future empirical work. The paper is structured in the following breakouts: review of the literature; a detailed methodology outline; data description; summary of an empirical results template; and conclusions.

2. Literature Review

The relationship between exchange rate volatility and trade performance has been a subject of extensive research globally. In the context of Moldova, however, the literature remains relatively sparse. This section retrieves the key findings from five relevant sources that, while not directly estimating the impact of exchange rate volatility on exports, provide critical insights into the mechanisms through which exchange rate dynamics influence Moldova's trade and economic performance.

Giucci and Staske (2025) argue that Moldova's historical reliance on the U.S. dollar as a reference currency has contributed to unnecessary exchange rate volatility, particularly given the country's stronger trade ties with the Eurozone. Their policy brief advocates for a shift

to the euro as a reference currency to enhance predictability and reduce transaction costs for exporters (Giucci & Staske, 2025).

Gaiu (n.d.) provides a comprehensive analysis of how exchange rate fluctuations affect various economic agents in Moldova, including exporters. The study emphasizes the role of currency risk and its implications for trade decisions, highlighting the need for stable exchange rate policies to support export growth (Gaiu, n.d.).

OGResearch (2023) examines Moldova's real effective exchange rate (REER) and identifies signs of overvaluation, which could undermine export competitiveness. Although the study does not focus on volatility per se, it underscores the importance of maintaining a competitive exchange rate to support external trade.

The IMF (2022) Selected Issues Report includes an in-depth discussion of exchange rate volatility in Moldova, its transmission to inflation, and broader macroeconomic implications. While not centered on exports, its report provides valuable context for understanding how volatility can affect trade indirectly through price stability and investor confidence (IMF, 2022).

Finally, the National Bank of Moldova (2024) introduced new interbank FX market indicators aimed at reducing volatility. These institutional efforts are crucial for creating a stable environment conducive to export growth and foreign investment (National Bank of Moldova, 2024).

Despite these contributions, a notable gap remains in the form of empirical studies that directly quantify the impact of exchange rate volatility on Moldova's export performance. This absence highlights the need for future research that applies econometric models to evaluate the volatility-export nexus in the Moldovan context.

3. Methodology

Most practitioners in this field suggest measuring *Exchange Rate Volatility with GARCH Models* (GARCH(1,1), EGARCH and TGARCH) as these models help us capture time-varying volatility in the MDL/EUR and MDL/USD exchange rates.

Therefore, we will be starting by using monthly Moldova REER data for the period from the years of 1997 to 2025 (**1997M01–2025M12 (348 observations)**), to compute log returns

$$r_t = \ln(REER_t/REER_{t-1}) \quad (1)$$

and estimate a **GARCH(1,1)** model by maximum likelihood. The conditional variance follows:

$$h_t = \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1}, \quad (2)$$

assuming concomitantly:

$$\varepsilon_t | F_{t-1} \sim N(0, h_t) \quad (3)$$

$$\text{where } \varepsilon_t = r_t - \mu. \quad (4)$$

Table 1, depicts the estimated parameters that are given by $\mu = 0.00298$, $\omega = 0.000279$, $\alpha = 0.3346$, and $\beta = 0.1608$, implying volatility is stationary with $\alpha + \beta = 0.495 < 1$. The time-varying volatility proxy is the conditional standard deviation $\sigma_t = \sqrt{h_t}$, which we annualize for monthly data as $\sigma_t^{ann} = \sqrt{12} \sigma_t$. Over the sample, annualized

conditional volatility averages **0.0777** (median **0.0686**), with the latest value **0.0644** and a maximum of **0.5446**.

Table 1. GARCH(1,1) estimates for Moldova monthly REER returns (1997M01–2025M12)

Parameter	Description	Estimate
μ	Mean return	0.002980
ω	Constant	0.000279
α	ARCH term	0.334600
β	GARCH term	0.160770
$\alpha+\beta$	Persistence (stationarity check)	0.495370

Source: Author's own estimates using monthly Real Effective Exchange Rate (REER) index data for the Republic of Moldova from the National Bank of Moldova. The REER is defined by the NBM as a trade-weighted exchange-rate indicator adjusted for relative inflation, commonly used to assess external price competitiveness. Monthly returns were calculated as log-differences of the REER index, and GARCH(1,1) parameters were estimated by the author for 1997M01–2025M12. Econometric estimations were implemented in R using packages including *fixest*, *AER*, *urca*, and *countrycode*.

Notes: Returns are computed as $r_t = \ln(\text{REER}_t/\text{REER}_{t-1})$. The conditional variance is $h_t = \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1}$, with $\varepsilon_t = r_t - \mu$. Estimates obtained by maximum likelihood under conditional normality. **Explanations:** **Mean return** is positive ($\mu=0.00298$), implying an average monthly increase in log REER returns (need to interpret them cautiously; as returns are small). Volatility dynamics show **moderate persistence**: $\alpha+\beta=0.495$. This suggests shocks to REER volatility decay relatively quickly compared to typical high-persistence FX series; The **ARCH component** is larger than the GARCH component ($\alpha=0.335$ vs $\beta=0.161$), meaning volatility reacts more to **recent shocks** than to long memory.

Now, using the same monthly Moldova REER data for **1997M01–2025M12**, we will compute log returns:

$$r_t = \ln(\text{REER}_t/\text{REER}_{t-1}), \quad (5)$$

and estimate an **EGARCH(1,1)** model by maximum likelihood under conditional normality, especially because it can capture asymmetry/ “leverage effects” without forcing variance positivity constraints. Conditional variance is specified as:

$$\ln h_t = \omega + \beta \ln h_{t-1} + \alpha(|z_{t-1}| - E|z|) + \gamma z_{t-1}, \quad (6)$$

$$\text{where } z_t = \varepsilon_t/\sqrt{h_t}, \quad (7)$$

$$\text{and } E|z| = \sqrt{2/\pi}. \quad (8)$$

Table 2. EGARCH(1,1) estimates for Moldova monthly REER returns (1997M01–2025M12)

Parameter	Description	Estimate
μ	Mean return	0.003068
ω	Constant (log-variance eq.)	0.000000
α	Magnitude	0.631453
γ	Asymmetry / leverage	0.036928
β	Persistence	0.980000

Sources: Author's calculations based on monthly Real Effective Exchange Rate (REER) index data for the Republic of Moldova obtained from the National Bank of Moldova. Monthly REER returns were computed as log-differences of the REER index, and the EGARCH(1,1) model was estimated by the author for 1997M01–2025M12.

Notes: Returns are $r_t = \ln(\text{REER}_t/\text{REER}_{t-1})$. The variance dynamics follow $\ln h_t = \omega + \beta \ln h_{t-1} + \alpha(|z_{t-1}| - E|z|) + \gamma z_{t-1}$, with $z_t = \varepsilon_t/\sqrt{h_t}$ and $E|z| = \sqrt{2/\pi}$. Estimates obtained by maximum likelihood assuming conditional normality. In the EGARCH specification, α captures the magnitude effect of shocks on conditional volatility, while γ captures possible asymmetric or leverage effects.

In **Table 2** are presented the estimated parameters $\mu = 0.003068$, $\omega \approx 0$, $\alpha = 0.631453$, $\gamma = 0.036928$, and $\beta = 0.98$, implying highly persistent volatility dynamics ($|\beta| < 1$). The asymmetry term is positive but small, suggesting only limited evidence that the sign of shocks materially changes volatility relative to shock magnitude. Volatility is measured as $\sigma_t = \sqrt{h_t}$ and annualized for monthly data as $\sigma_t^{\text{ann}} = \sqrt{12} \sigma_t$.

Continuing using monthly Moldova REER data for **1997M01–2025M12**, we compute log returns $r_t = \ln(\text{REER}_t/\text{REER}_{t-1})$ similarly as in equation (5) and estimate a **TGARCH (GJR-GARCH)(1,1)** model by maximum likelihood under conditional normality. The conditional variance follows:

$$h_t = \omega + \alpha \varepsilon_{t-1}^2 + \gamma 1(\varepsilon_{t-1} < 0) \varepsilon_{t-1}^2 + \beta h_{t-1}, \quad (9)$$

$$\text{where } \varepsilon_t = r_t - \mu. \quad (10)$$

Table 3. shows the estimated parameters $\mu=0.003274$, $\omega=0.000326$, $\alpha=0.072772$, $\gamma=0.422166$, and $\beta=0.089230$, with $\alpha+0.5\gamma+\beta=0.373<1$ indicating stationarity. The threshold term is positive ($\gamma>0$), implying that negative shocks to REER returns generate higher conditional volatility than positive shocks of the same magnitude. Volatility is measured as $\sigma_t = \sqrt{h_t}$ and annualized for monthly data as $\sigma_t^{\text{ann}} = \sqrt{12} \sigma_t$.

Table 3. TGARCH (GJR-GARCH)(1,1) estimates for Moldova monthly REER returns (1997M01–2025M12)

Parameter	Description	Estimate
μ	Mean return	0.003274
ω	Constant	0.000326
α	ARCH term	0.072772
γ	Threshold (asymmetry)	0.422166
β	GARCH term	0.089230
$\alpha+0.5\gamma+\beta$	Stationarity check	0.373085
LL	Total log-likelihood	842.6394

Sources: Author's calculations based on monthly Real Effective Exchange Rate (REER) index data for the Republic of Moldova obtained from the National Bank of Moldova. Monthly REER returns were computed as log-differences of the REER index, and the TGARCH/GJR-GARCH(1,1) model was estimated by the author for 1997M01–2025M12.

Notes: Monthly returns are computed as $r_t = \ln(REER_t/REER_{t-1})$ for the period **1997M01–2025M12**. The mean equation is $r_t = \mu + \varepsilon_t$, with $\varepsilon_t | F_{t-1} \sim N(0, h_t)$. The conditional variance follows the TGARCH (GJR-GARCH)(1,1) specification $h_t = \omega + \alpha \varepsilon_{t-1}^2 + \gamma 1(\varepsilon_{t-1} < 0) \varepsilon_{t-1}^2 + \beta h_{t-1}$ where $1(\varepsilon_{t-1} < 0)$ is an indicator for negative shocks. Parameters are estimated by maximum likelihood assuming conditional normality; stationarity is assessed using $\alpha + 0.5\gamma + \beta < 1$. A positive γ indicates that negative return shocks increase volatility more than positive shocks of the same magnitude (asymmetric volatility). The dependent variable is the monthly logarithmic return of the REER index. The TGARCH/GJR-GARCH(1,1) model captures volatility persistence and possible threshold/asymmetric effects. The stationarity condition is evaluated using $\alpha + 0.5\gamma + \beta$, which equals **0.373085**, indicating a stationary conditional variance process.

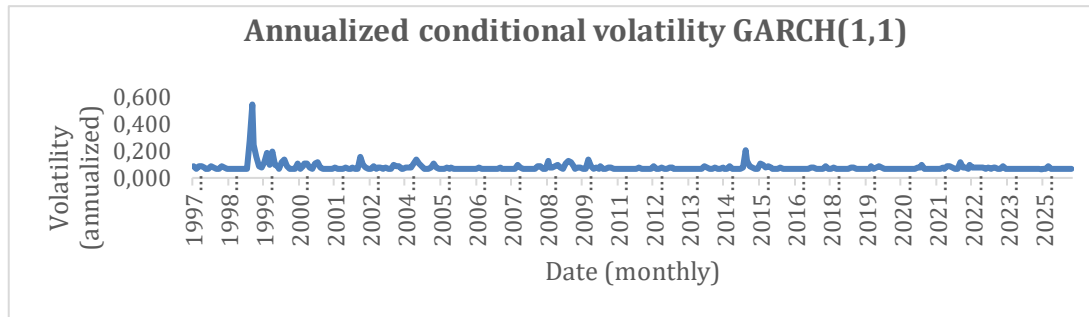


Figure 1. Annualized conditional volatility estimated from a GARCH(1,1) model on monthly REER returns, $\sigma_t^{ann} = \sqrt{12h_t}$.

For an alternative perspective, and by looking at these estimations as a non-parametric benchmark, we compute the rolling volatility as **the standard deviation of exchange-rate log returns over a fixed window**. Let:

$$r_t = \Delta \ln(s_t). \quad (11)$$

Rolling volatility is defined as

$$\sigma_t^{(w)} = \text{sd}(r_{t-w+1}, \dots, r_t), \quad (12)$$

$$\text{with } w = 12 \text{ months, and is annualized as } \sigma_t^{ann} = \sqrt{12}\sigma_t^{(w)}. \quad (13)$$

This measure is model-free and provides a transparent comparison to conditional volatility from GARCH-type models.

Simultaneously, in order to capture uncertainty as *unpredictability* rather than realized volatility, we construct an **exchange-rate uncertainty index** from one-step-ahead forecast errors. Using an AR(1) benchmark for returns,

$$r_t = c + \phi r_{t-1} + u_t, \quad (14)$$

we define uncertainty as:

$$U_t = |FE_t| (\text{or } FE_t^2), \quad (15)$$

$$\text{where } FE_t = r_t - \hat{r}_{t|t-1}. \quad (16)$$

The series is aggregated to annual frequency (average within year) and normalized for comparability across measures.

In the next paragraphs, to allow for asymmetric effects on log exports we will use annual exports data of the Republic of Moldova for 1997–2024, to estimate a nonlinear ARDL (NARDL) model in which log REER is decomposed into positive and negative partial sums. As we can observe in **Table 4**, the error-correction term is negative and statistically

significant ($\lambda = -2.095$, $p = 0.008$), indicating rapid adjustment toward the long-run equilibrium. Long-run coefficients show a statistically significant effect for the positive REER component ($\beta^+ = 1.387$, $p < 0.001$) while the negative component is not significant ($\beta^- = 0.050$, $p = 0.890$). Wald tests reject symmetry both in the long run ($p = 0.0096$) and in the short run ($p = 0.0209$), supporting asymmetric exchange-rate effects on exports. Standard diagnostics indicate no residual autocorrelation, heteroskedasticity, non-normality, or functional-form misspecification (all $p > 0.10$).

Table 4. NARDL long-run asymmetry results (1997–2024)

Item	Value
Bounds F-statistic	4.540
Bounds t-statistic	−3.544
ECM coefficient (λ)($on(lx_{t-1})$)	−2.095 (p=0.0076)
Long-run (β^+)(<i>REERpositive</i>)	1.387 (p<0.001)
Long-run (β^-)(<i>REERnegative</i>)	0.050 (p=0.890)
Long-run asymmetry test (Wald)	p=0.0096
Short-run asymmetry test (Wald)	p=0.0209
BG serial correlation	p=0.943
ARCH LM	p=0.915
Normality	p=0.655
RESET	p=0.446

Sources: Author's own NARDL estimates using annual data for 1997–2024. Export data are taken from the National Bureau of Statistics of the Republic of Moldova; REER data are taken from the National Bank of Moldova; and the foreign-demand proxy is based on World Bank World Development Indicators data. The REER positive and negative partial-sum variables were constructed by the author to test for asymmetric effects.

Notes: Positive/negative components are constructed as partial sums of $\Delta \ln REER_t$. The dependent variable is $\ln X_t$. Case 3 bounds-test critical values (intercept, no trend) are used. The dependent variable is the logarithm of Moldova's exports. The REER variable is decomposed into positive and negative partial sums in order to test whether REER appreciations and depreciations have asymmetric effects on exports. The long-run and short-run asymmetry tests are based on Wald tests. Diagnostic tests report p-values for serial correlation, ARCH effects, normality, and functional-form stability.

Returning to the conventional definition of the REER (an increase denotes real appreciation), the NARDL estimates indicate that exports respond asymmetrically: real appreciations have a statistically significant long-run effect, whereas real depreciations do not, and symmetry is rejected in both the short and long run. In the linear ARDL, we can see that the long-run REER elasticity is positive but statistically insignificant ($\hat{\beta}_{REER} = 0.714$, $p = 0.33$).

To confirm that by using Moldova's annual export data (1997–2024), we will perform an estimate of a linear ARDL export equation in error-correction form. In **Table 5**, the error-correction (adjustment) coefficient is negative and statistically significant (-0.452 , $p=0.036$), implying that roughly 45% of deviations from the long-run equilibrium are corrected within one year. Long-run multipliers indicate a strong positive association between exports and foreign demand, while the competitiveness effect is weaker: the implied long-run elasticity is 0.714 for REER ($p=0.328$) and 3.974 for EU GDP ($p=0.059$). In the short run, changes in foreign demand are positive and significant ($\Delta lfd = 3.381$, $p=0.0098$),

whereas short-run REER changes are not statistically significant. Overall model fit is adequate (adjusted $R^2 = 0.49$).

Table 5. Linear ARDL (UECM) estimates and implied long-run elasticities (annual, 1997-2024)

Panel A. Error-correction form (UECM)

Variable	Estimate	Std. Error	p-value
$L(\ln X, 1)$	-0.4515	0.1985	0.0362
$L(\ln REER, 1)$	0.3224	0.3747	0.4014
$L(\ln FD, 1)$	1.7941	1.1701	0.1436
$\Delta L(\ln X, 1)$	0.5282	0.2176	0.0266
$\Delta \ln REER$	0.4365	0.3936	0.2828
$\Delta L(\ln REER, 1)$	-0.4934	0.3468	0.1729
$\Delta \ln FD$	3.3806	1.1630	0.0098
$\Delta L(\ln FD, 1)$	-2.1817	1.1858	0.0833

Sources: Author's own estimates using annual data for 1997–2024. Export data are taken from the National Bureau of Statistics of the Republic of Moldova; REER data are taken from the National Bank of Moldova; and the foreign-demand variable is proxied by European Union GDP from the World Bank World Development Indicators. Variables are expressed in logarithms, and the ARDL/UECM specification is estimated by the author.

Notes: Model fit: $R^2=0.6555$, adjusted $R^2=0.4933$; $N \approx 26$ (depending on lags). The dependent variable is the logarithm of Moldova's exports. $\ln REER$ denotes the logarithm of the Real Effective Exchange Rate index, while $\ln FD$ denotes the logarithm of the foreign-demand proxy. Panel A reports the unrestricted error-correction form, while the implied long-run elasticities are derived from the estimated level coefficients.

Panel B. Implied long-run elasticities (multipliers)

Long-run effect	Estimate	Std. Error	p-value
REER	0.7142	0.7095	0.3283
Foreign demand (EU GDP)	3.9737	1.9624	0.0592

Sources: Author's own estimates using annual data for 1997–2024. Export data are taken from the National Bureau of Statistics of the Republic of Moldova; REER data are taken from the National Bank of Moldova; and foreign demand is proxied by European Union GDP from the World Bank World Development Indicators. The reported long-run multipliers are derived from the estimated ARDL/UECM coefficients.

Notes: The long-run elasticities are computed from the level coefficients of the unrestricted error-correction model. The REER elasticity measures the long-run association between Moldova's exports and the real effective exchange rate, while the foreign-demand elasticity measures the long-run association between Moldova's exports and EU GDP used as an external demand proxy.

In the linear ARDL with specification $ARDL(1,0,0)$ presented in Tables 6 and 7, the bounds test rejects the null of no cointegration ($F=7.71$, $p=0.002$), supporting a stable long-run relationship between exports, REER, and foreign demand. Long-run elasticities indicate that foreign demand (EU real GDP) has a strong positive effect on exports ($\hat{\beta}_{FD} = 5.09$,

$p=0.0026$), whereas the REER elasticity is positive but statistically insignificant ($\hat{\beta}_{REER} = 0.44, p = 0.40$).

Table 6. Linear ARDL long-run elasticities (ARDL(1,0,0), 1997–2024)

Term	Estimate	Std. Error	p-value
$\ln REER (\hat{\beta}_{REER})$	0.4386	0.5164	0.404
$\ln FD$ (EU GDP)	5.0888	1.5047	0.0026
Bounds F-test	7.7114		0.0020

Sources: Author's own estimates using annual data for 1997–2024. Export data are taken from the National Bureau of Statistics of the Republic of Moldova; the REER series is taken from the National Bank of Moldova; and foreign demand is proxied by European Union GDP from the World Bank World Development Indicators. The reported coefficients represent estimated long-run elasticities from the linear ARDL(1,0,0) specification.

Notes: The dependent variable is the logarithm of Moldova's exports $\ln X_t$. $\ln REER$ denotes the logarithm of the Real Effective Exchange Rate index, while $\ln FD$ denotes the logarithm of foreign demand, proxied by European Union GDP. The Bounds F-test is used to assess the existence of a long-run relationship among the variables. Bounds test is for the null of no cointegration (case 3).

Table 7. Linear ARDL(1,0,0) results for total exports, Moldova (1997–2024)

Panel A. Bounds test for cointegration (Pesaran et al.)

Test	Statistic	p-value	Conclusion
Bounds F-test (no cointegration)	7.7114	0.0020	Reject (H_0) : cointegration

Panel B. Error-correction model (ECM) estimates

Term	Estimate	Std. Error	p-value
Constant	−70.9477	18.5643	0.000875
$\ln X_{t-1}$	−0.5015	0.1281	0.000696
$(\ln REER_t)$	0.2200	0.2918	0.4586
$(\ln FD_t)(EUGDP)$	2.5522	0.6542	0.000719

Panel C. Implied long-run elasticities

Variable	Long-run elasticity
$(\ln REER)$	0.4386
$(\ln FD)(EUGDP)$	5.0888

Sources: Author's own estimates using annual data for 1997–2024. Export data are taken from the National Bureau of Statistics of the Republic of Moldova; the REER series is taken from the National Bank of Moldova; and foreign demand is proxied by European Union GDP from the World Bank World Development Indicators. The Bounds test, ECM coefficients, and implied long-run elasticities are derived from the estimated linear ARDL(1,0,0) model.

Notes: Dependent variable is $\ln X_t$, where X_t is total exports (USD). FD_t is EU real GDP. Annual sample 1997–2024. Panel A reports the bounds test for the null of no cointegration (case 3: intercept, no trend). Panel C long-run elasticities are computed as $-\theta/\lambda$, where λ is the coefficient on $\ln X_{t-1}$ and θ is the relevant level coefficient in Panel B.

The NARDL results in Table 8 indicate statistically significant **asymmetry**: long-run effects are concentrated in REER increases (real appreciations), while REER decreases (real depreciations) are not significant; diagnostic tests support model adequacy.

Table 8. NARDL results for total exports and REER asymmetry, Moldova (1997–2024)

Panel A. Cointegration (Bounds) tests

Test	Statistic	Notes
Bounds F-statistic	4.5398	Inconclusive at 10% (above lower bound 4.29, below upper bound 5.08); below 5% lower bound (5.395)
Bounds t-statistic	−3.5440	Significant vs. 10%/5% critical bands; supports cointegration

Panel B. Error-correction (UECM) estimates

Term	Estimate	Std. Error	p-value
Constant	28.3557	8.0735	0.00794
$\ln X_{t-1}$	−2.0946	0.5910	0.00758
$REER_{t-1}^+$	2.9044	0.9118	0.01289
$REER_{t-1}^-$	0.1044	0.7415	0.89156

(Short-run differenced terms are included in the estimation; see notes.)

Panel C. Long-run elasticities and asymmetry tests

Item	Value	p-value
Long-run β^+ (REER increases)	1.3866	<0.001
Long-run β^- (REER decreases)	0.0498	0.8899
Long-run asymmetry (Wald)	11.4406	0.0096
Short-run asymmetry (Wald)	8.2173	0.0209

Panel D. Diagnostics

Test	p-value
Breusch–Godfrey serial correlation	0.9431
ARCH LM	0.9154
Normality	0.6554
RESET	0.4463

Sources: Author's calculations using annual data for 1997–2024. Moldova's total export data are taken from the National Bureau of Statistics of the Republic of Moldova; REER data are taken from the National Bank of Moldova; and foreign demand is proxied by European Union GDP from the World Bank World Development Indicators. The NARDL positive and negative partial-sum decomposition and asymmetry tests follow Shin *et al.* (2014), while the Bounds-test approach follows Pesaran, Shin and Smith (2001).

Notes: Dependent variable is $\ln X_t$ (total exports, USD). $REER^+$ and $REER^-$ are partial sums of positive and negative changes in $\Delta \ln REER_t$. Cointegration is assessed using case 3 critical values (intercept, no trend). Panel B reports the key level terms of the UECM; the full model includes lagged differences of $\Delta \ln X_t$, $\Delta REER_t^+$, and $\Delta REER_t^-$ as in our earlier NARDL output. Annual sample 1997–2024.

Just as a general signpost in our estimations by far, in the Bruegel CPI-based REER index, increases denote real appreciation; therefore, the NARDL positive partial sum captures

appreciations ($\Delta \ln REER_t > 0$) and the negative partial sum captures depreciations ($\Delta \ln REER_t < 0$).

By completing those ARDL/NARDL estimates, we will turn now to analyze Moldova's bilateral export flows for the years 1997–2024 using a gravity framework estimated by **Poisson Pseudo-Maximum Likelihood (PPML)**. PPML is appropriate for trade data because it is robust to heteroskedasticity and accommodates **zero trade flows** while keeping the dependent variable in **levels** (rather than requiring log-transformation). To control for time-invariant partner characteristics and common global shocks, we include **importer fixed effects** and **year fixed effects**, and cluster standard errors by importer to allow for within-partner dependence over time.

The baseline specification in our case is:

$$X_{it} = \exp[\beta_1(EU_i \times Post2014_t) + \beta_2(EU_i \times Post2022_t) + \alpha_i + \delta_t]\varepsilon_{it} \quad (17)$$

where X_{it} denotes Moldova's exports to partner i in year t , α_i are importer fixed effects, and δ_t are year fixed effects. The interaction $EU_i \times Post2014_t$ captures the differential change in exports to EU partners after **2014 (DCFTA period)** relative to non-EU partners, while $EU_i \times Post2022_t$ measures any additional **EU-specific** change after 2022 (note that year fixed effects absorb shocks common to all partners in each year).

The baseline PPML model includes 38 importer fixed effects and 28 year fixed effects and achieves a high adjusted pseudo- R^2 (≈ 0.91), indicating that partner heterogeneity and common time shocks explain a substantial share of the variation in bilateral exports. Fit statistics (log-likelihood and BIC) are reported to benchmark and compare alternative specifications.

In Table 9 we report the PPML estimates' results. The coefficient on $EU \times post-2014$ is positive and highly significant across specifications, indicating a strong post-2014 increase in exports to EU partners relative to non-EU partners after controlling for importer and year effects. By converting the coefficient to percentage terms, using:

$$(e^\beta - 1) \times 100, \quad (18)$$

the post-2014 EU effect implies an increase of approximately +250 – 263% (DCFTA effect (model 2): $e^{1.289} - 1 \approx 263\%$, DCFTA effect (model 3, 2014–2021): $e^{1.254} - 1 \approx 250\%$). By contrast, the $EU \times post-2022$ coefficient is small and statistically insignificant ($e^{0.0932} - 1 \approx 9.8\%$), suggesting no clear additional EU-specific structural break from 2022 onward, once common year shocks are controlled for.

Table 9. PPML estimates of Moldova's bilateral exports: DCFTA (2014) and 2022 shock

	(1) Baseline	(2) DCFTA	(3) DCFTA + 2022
EU × post-2014 (eu_post2014)		1.289*** (0.3252)	1.254*** (0.1804)
EU × post-2022 (eu_post2022)			0.0932 (0.6015)
Importer FE (imp_iso3)	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
SE clustered by importer	—	Yes	Yes
Observations	1,064	1,064	1,064
Squared Cor.	0.7890	0.8925	0.8945
Pseudo R ²	0.9111	0.9405	0.9405
BIC	11,718,470.8	7,845,436.6	7,836,126.3

Sources: Author's PPML estimates using Moldova's bilateral export data by partner country from the National Bureau of Statistics of the Republic of Moldova for 1997–2024. The $EU \times \text{post-2014}$ variable is constructed by the author to capture the provisional application of the EU–Moldova Association Agreement/DCFTA since September 2014, while the $EU \times \text{post-2022}$ variable captures the post-2022 external shock period. Importer and year fixed effects are included, with standard errors clustered by importer. PPML estimation follows Santos Silva and Tenreyro (2006), with high-dimensional fixed effects implemented following Correia, Guimarães and Zylkin (2020).

Notes: Dependent variable is bilateral exports (levels). Estimation by PPML with importer and year fixed effects. Standard errors clustered by importer (imp_iso3). Significance: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. The percentage effect translation shows the following magnitudes: $1.289 \approx +263\%$; $1.254 \approx +250\%$; $0.093 \approx +10\%$ but insignificant

Overall, the PPML findings align with the time-series results: external demand and policy regime shifts (DCFTA period) are central in explaining export dynamics, while competitiveness effects captured by REER are weaker in the linear model and appear mainly through asymmetry in NARDL.

For more clarity in our above estimates, we will concentrate on interpreting the essence of each number:

- **dcfta_pct = 262.88%**. From the model with only $EU \times \text{post-2014}$, this means exports to EU partners are estimated to be about **263% higher** after 2014 **relative to non-EU partners**, controlling for importer and year fixed effects.
- **dcfta_2014_2021_pct = 250.40%**. In the model with both interactions, this is the EU post-2014 effect **for 2014–2021** (before the 2022 interaction kicks in): about **250% higher** relative to non-EU.
- **shock_increment_pct = 9.77%**. This is the **additional change from 2022 onward** for EU partners (the coefficient on $EU \times \text{post-2022}$): about **+9.8%** on top of the post-2014 effect. In our table it was **not statistically significant**, so it could be treated as “no clear EU-specific 2022 shift.”
- **dcfta_post2022_total_pct = 284.63%**. This is the **total EU effect after 2022**, combining both coefficients: $e^{\beta_{2014} + \beta_{2022}} - 1$. So, from **2022 onward**, exports to EU partners are estimated to be about **285% higher** relative to non-EU, in that specification.

In **Table 9**, we notice that the coefficient on $EU \times \text{post-2014}$ is **positive and highly significant** (1.254), indicating that Moldova's exports to EU partners increased strongly after the DCFTA period began, relative to non-EU partners, after controlling for importer fixed effects and common year shocks. The $EU \times \text{post-2022}$ coefficient is **small and statistically insignificant** (0.093), suggesting there is no clear additional EU-specific break in exports from 2022 onward once the general 2022–2024 shocks (captured by year fixed effects) are accounted for. The high pseudo- (R^2) (0.94) and squared correlation (0.89) imply the model with fixed effects fits the bilateral export pattern well.

In short, the interpretation of the two-policy model (ppml_both) gives us the following conclusions:

- eu_post2014 = estimated **DCFTA-era shift** in exports to EU relative to non-EU partners (net of importer FE and year FE).

- eu_post2022 = **additional change from 2022 onward** for EU partners (captures “2022 shock” differential).

If eu_post2022 is negative, it means EU flows fell relative to non-EU after 2022; if positive, they rose.

Across methods, the results point to **external demand and policy regime shifts** as the main drivers of Moldova’s export dynamics, while **price-competitiveness effects are weaker and asymmetric**. In the time-series ARDL/NARDL models, EU GDP has a strong positive effect on exports, whereas the REER effect is generally weak in the linear specification but becomes asymmetric in NARDL (with appreciations and depreciations behaving differently). Consistent with this, the PPML gravity estimates show a large, robust increase in bilateral exports to EU partners after **2014 (DCFTA)**, while the additional **2022 shock** term is not EU-specific once common year shocks are controlled for, suggesting the post-2014 policy anchor matters more than a differential partner-group break in 2022.

Simultaneously, to assess whether the DCFTA-related shift in exports to EU partners depends on Moldova’s macro-financial environment, we will estimate a Hansen-style panel threshold model, proxied by annual exchange-rate volatility. Formally, we estimate:

$$y_{it} = \beta_L(EU_i \times Post2014_t)1(vol\_ann_t \leq \hat{\gamma}) + \beta_H(EU_i \times Post2014_t)1(vol\_ann_t > \hat{\gamma}) + \alpha_i + \delta_t + \varepsilon_{it}, \quad (19)$$

$$\text{where: } y_{it} = \log(1 + exports_{it}) \quad (20)$$

while α_i and δ_t denote importer and year fixed effects. The threshold γ is selected by grid search over trimmed candidate values (10%–90%) to minimize the residual sum of squares, and standard errors are clustered by importer. In **Table 10** the estimated volatility threshold is $\hat{\gamma} = 116.366$, which splits the sample into low- and high-volatility regimes.

Table 10. Hansen-type panel threshold results (threshold variable: annual volatility)

Item	Result
Threshold variable q_t	Annual volatility (vol_ann)
Estimated threshold $\hat{\gamma}$	116.366
Dependent variable	$y_{it} = \log(1 + exports_{it})$
Fixed effects	Importer FE + Year FE
SE	Clustered by importer

Sources: Author’s own estimates using Moldova’s bilateral export data from the National Bureau of Statistics of the Republic of Moldova and monthly REER data from the National Bank of Moldova. The threshold variable, annual volatility (vol_ann), is constructed from monthly REER returns. The panel threshold specification follows Hansen’s threshold-regression approach and is estimated with importer and year fixed effects, with standard errors clustered by importer.

Note: The dependent variable is $y_{it} = \log(1 + exports_{it})$, where iii denotes importer partner and t denotes year. The estimated threshold $\gamma = 116.366$ separates observations into low- and high-volatility regimes. The threshold variable q_{it} is the annual REER volatility series constructed by the author.

The post-2014 EU (DCFTA) effect shown in **Table 11** is positive and statistically significant in both regimes, but substantially larger under high volatility: the coefficient equals 1.345 ($p=0.048$) in the low-volatility regime and 2.184 ($p=0.003$) in the high-volatility regime. A formal difference test rejects equality of the regime coefficients (high–low = 0.838, $p=0.0013$), confirming a statistically meaningful threshold effect. These results suggest that

Moldova's post-2014 export reorientation toward EU partners is robust and appears even stronger during periods of elevated volatility.

Table 11. Regime-specific DCFTA effect ($EU \times \text{post-2014}$):

Coefficient	Estimate	Std. Error	p-value
$EU \times \text{Post2014 (lowvol, } vol_{ann} \leq \hat{\gamma})$	1.345	0.652	0.048
$EU \times \text{Post2014 (highvol, } vol_{ann} > \hat{\gamma})$	2.184	0.673	0.003

Sources: Author's calculations based on Moldova's bilateral export data by partner country from the National Bureau of Statistics of the Republic of Moldova and monthly Real Effective Exchange Rate (REER) data from the National Bank of Moldova. Annual REER volatility (vol_{ann}) was constructed by the author from monthly REER returns. The $EU \times \text{post-2014}$ variable is constructed to capture the DCFTA period following the provisional application of the EU–Moldova Association Agreement from 1 September 2014. Regime-specific coefficients are estimated using the Hansen-type panel threshold model with importer and year fixed effects.

Note: The table reports the estimated DCFTA effect separately for low-volatility and high-volatility regimes, where the regime split is determined by the estimated annual volatility threshold $\hat{\gamma} = 116.366$. Standard errors are clustered by importer. A larger coefficient in the high-volatility regime suggests that the DCFTA effect is stronger when REER volatility exceeds the estimated threshold. **Difference test:** High – Low = 0.838 (SE 0.235), $t = 3.56$, $p = 0.0013$.

This threshold result complements the PPML gravity findings of a strong post-2014 DCFTA shift toward EU markets by showing that the EU effect is **not only robust on average**, but **significantly larger when exchange-rate volatility is high** (the regime identified earlier using the GARCH-based annual volatility measure).

Table 12. PPML with importer and year fixed effects (BNS bilateral exports), Moldova 1997–2024

	(1) Baseline	(2) DCFTA + 2022
$EU \times \text{post-2014 (eu\_post2014)}$		0.8435** (0.2931)
$EU \times \text{post-2022 (eu\_post2022)}$		0.0931 (0.3946)
Importer FE	Yes	Yes
Year FE	Yes	Yes
SE clustered by importer	—	Yes
Observations	2,032	2,032
Pseudo R ²	0.9160	0.9287
BIC	1.52e+10	1.29e+10

Sources: Author's PPML estimates using Moldova's bilateral export data by partner country from the National Bureau of Statistics of the Republic of Moldova for 1997–2024. The $EU \times \text{post-2014}$ variable is constructed by the author to capture the DCFTA period following the provisional application of the EU–Moldova Association Agreement from 1 September 2014, while the $EU \times \text{post-2022}$ variable captures the post-2022 shock period. The model includes importer and year fixed effects, with standard errors clustered by importer.

Notes: Dependent variable is bilateral exports (USD, levels). Models are estimated by PPML with importer and year fixed effects. The PPML approach follows Santos Silva and Tenreyro (2006), and the high-dimensional fixed-effects implementation follows Correia, Guimarães and Zylkin (2020). Standard errors are clustered by importer. Significance: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Percentage effects (when reported) are computed as $(e^{\beta} - 1) \times 100$.

Turning back to estimating the PPML models of Moldova's exports to partner i in year t with importer fixed effects and year fixed effects, we control for time-invariant partner

characteristics and common shocks affecting all partners in each year, while standard errors are clustered by importer. Policy and shock effects are identified via interactions of partner group membership (EU/CIS) with post-period indicators.

As a result, the PPML estimates presented in **Table 12** indicate a positive and statistically significant EU-specific shift after 2014: the coefficient on $EU \times post2014$ equals **0.844** ($p < 0.01$), implying an increase of approximately **+132%** in exports to EU partners relative to non-EU partners, conditional on importer and year fixed effects $((e^\beta - 1) \times 100)$: DCFTA (2014–2021) shows **+132.4%**. In contrast, the $EU \times post2022$ term is small and statistically insignificant (EU change after 2022: **+9.8%**), suggesting no clear additional EU-specific structural break after 2022 (Total EU effect after 2022: **+155.1%**) once common year shocks are absorbed by year fixed effects.

As a robustness check, we add a $CIS \times post2022$ interaction to test whether the post-2022 adjustment differs for CIS destinations. In Table 13, the main post-2014 EU effect remains stable, and neither the EU- nor CIS-specific post-2022 interaction is statistically significant, indicating limited evidence of partner-group-specific structural breaks in 2022 beyond the general year effects.

Adding a $CIS \times post2022$ term does not alter the core result that the DCFTA-era EU shift remains large and significant. Neither the $EU \times post2022$ nor $CIS \times post2022$ interaction is statistically significant, suggesting that once common year shocks are absorbed by year fixed effects, there is no robust evidence of an additional partner-group-specific structural break in 2022 for EU or CIS destinations.

Table 13. 2022 shock heterogeneity (EU vs CIS)

	(1) ppml_both	(2) ppml_shock2
EU $\times$ post-2014	0.8435** (0.2931)	0.8427** (0.2927)
EU $\times$ post-2022	0.0931 (0.3946)	-0.1464 (0.2824)
CIS $\times$ post-2022		-0.3657 (0.6933)
Importer FE	Yes	Yes
Year FE	Yes	Yes
SE clustered by importer	Yes	Yes
Observations	2,032	2,032
Pseudo R ²	0.9287	0.9293

Sources: Author's PPML estimates using Moldova's bilateral export data by partner country from the National Bureau of Statistics of the Republic of Moldova for 1997–2024. The $EU \times post-2014$ variable is constructed by the author to capture the DCFTA period following the provisional application of the EU–Moldova Association Agreement from 1 September 2014, while the $EU \times post-2022$ and $CIS \times post-2022$ variables are constructed to test heterogeneous post-2022 effects across partner groups. The models include importer and year fixed effects, with standard errors clustered by importer.

Notes: Dependent variable is bilateral exports (USD, levels). Models are estimated by PPML with importer and year fixed effects; standard errors are clustered by importer. $EU \times post2022$ and $CIS \times post2022$ measure partner-group-specific deviations after 2022 relative to the omitted group, conditional on year fixed effects (which absorb common shocks). Significance: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Finally, splitting EU destinations into the top five pre-2014 EU partners (ROU, ITA, DEU, POL, FRA) versus other EU partners yields positive and statistically significant post-2014 effects for both groups, with similar magnitudes (0.825 vs 0.912), as shown in Table 14.

This suggests the post-2014 export reorientation toward EU markets is broad-based rather than concentrated only among Moldova's largest EU destinations.

By splitting EU destinations into the top five pre-2014 partners versus the remaining EU partners, this yields positive and statistically significant post-2014 effects for both groups. As we can see in the Table 14, the magnitudes are similar (0.825 for top EU and 0.912 for other EU), indicating that the post-2014 reorientation toward EU markets is not concentrated solely among the Republic of Moldova's largest EU destinations, but is relatively broad-based across EU partners.

Table 14. DCFTA effect by top vs non-top EU partners

	(1) ppml_both	(2) ppml_top
EU × post-2014	0.8435** (0.2931)	
Top EU × post-2014		0.8252** (0.3079)
Other EU × post-2014		0.9122** (0.3340)
EU × post-2022	0.0931 (0.3946)	0.0931 (0.3947)
Importer FE	Yes	Yes
Year FE	Yes	Yes
SE clustered by importer	Yes	Yes
Observations	2,032	2,032
Pseudo R ²	0.9287	0.9288

Sources: Author's PPML estimates using Moldova's bilateral export data by partner country from the National Bureau of Statistics of the Republic of Moldova for 1997–2024. The EU × post-2014 variable is constructed by the author to capture the DCFTA period following the provisional application of the EU–Moldova Association Agreement from 1 September 2014. "Top EU" partners are defined by the author as the five EU destinations with the highest average Moldovan exports in the pre-2014 period: Romania, Italy, Germany, Poland and France. The models are estimated with importer and year fixed effects, with standard errors clustered by importer.

Notes: Dependent variable is bilateral exports (USD, levels). Models are estimated by PPML with importer and year fixed effects; standard errors are clustered by importer. "Top EU" partners are defined as the five EU destinations with the highest average exports in the pre-2014 period (ROU, ITA, DEU, POL, FRA). Significance: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Once we have finished with performing these estimates, and aiming to address potential reverse causality from exports to exchange-rate volatility, **we will conduct now an Identification Strategy**. In such a situation, we will estimate an instrumental-variables (2SLS) model in which annual volatility is treated as endogenous and instrumented with the **lagged annual-average ECB deposit facility rate (as shown in Table 15)**. The identifying rationale is that ECB policy shifts are external to the Republic of Moldova, affect her financial conditions and exchange-rate volatility, and - conditional on foreign demand - do not directly determine Moldova's exports.

The first-stage diagnostic indicates the instrument is relevant (weak-instrument statistic = 6.67, $p = 0.017$), although its strength is moderate. A Wu–Hausman test rejects exogeneity of volatility ($p = 0.0007$), supporting the use of IV. The IV estimates yield a negative effect of volatility on exports (coefficient -0.0136 ; robust $p = 0.075$), **implying that higher exchange-rate uncertainty is associated with lower export performance**; inference is somewhat sensitive to the choice of standard errors, but the sign is robust. Foreign demand remains strongly positive and statistically significant, consistent with earlier ARDL/NARDL results.

Table 15. Instrumental-variables estimates of the effect of exchange-rate volatility on exports (annual, 1997–2024). Observations = 25*Panel A. Second-stage (2SLS) results*

Variable	Estimate	Robust Std. Error	p-value
$\ln(FD)(EUGDP)$	10.512	2.473	0.00033
Volatility, vol_ann	−0.0136	0.00728	0.0755
Constant	−301.76	73.87	0.00049

Panel B. Diagnostics

Test	Statistic	p-value
Weak instruments (1 instrument)	6.667	0.0170
Wu–Hausman (endogeneity of volatility)	15.823	0.000685

Sources: Author's instrumental-variable/2SLS estimates using annual data for 1997–2024. Moldova's export data are taken from the National Bureau of Statistics of the Republic of Moldova; foreign demand is proxied by European Union GDP from the World Bank World Development Indicators; annual exchange-rate volatility (vol_ann) is constructed by the author from monthly REER data from the National Bank of Moldova; and the instrument is the lagged annual-average ECB deposit facility rate obtained from the European Central Bank. Robust standard errors are reported.

Notes: The endogenous regressor is annual exchange-rate volatility (vol_ann). The instrument is the lagged annual-average ECB deposit facility rate (ecb_dfr_avg_l1). Robust standard errors (HCl) are reported in Panel A. The model is exactly identified (one instrument for one endogenous regressor), so an overidentification test is not available. The sample is smaller due to ECB series availability and lagging.

To strengthen causal interpretation of the effect of exchange-rate volatility on exports, we employ an instrumental-variables (IV) strategy that exploits **external shocks** which plausibly affect the Republic of Moldova's exchange-rate volatility but are not driven by Moldova's export performance. The key requirement is that instruments satisfy **relevance** (they are strongly correlated with volatility) and the **exclusion restriction** (they affect exports only through the volatility channel, conditional on foreign demand controls and fixed effects where applicable). Below are descriptions of the main categories applied in this sense (also in Table 16).

Monetary policy shocks (ECB). The main instrument used in this paper section is the **lagged annual-average ECB deposit facility rate (DFR)**, which captures shifts in euro-area monetary policy and global financial conditions. Such policy changes are external to the Republic of Moldova, but can influence exchange-rate volatility through capital flows and risk premia, and are unlikely to be directly determined by Moldova's exports. To mitigate potential direct demand-channel effects, the export equation controls for **EU foreign demand** (EU GDP) and uses the **lagged** ECB rate.

Global risk indices (VIX). As a robustness instrument, the annual average (or end-year) **VIX** can be used to proxy global risk aversion and uncertainty. Increases in global risk typically raise exchange-rate volatility in emerging and small open economies through portfolio rebalancing and tighter external financial conditions. When using VIX, we control for foreign demand (EU GDP) to reduce the likelihood that the instrument captures export changes through global demand rather than volatility.

Commodity prices. Commodity price indices (e.g., oil or food price indices) may also serve as external instruments if the Republic of Moldova's exchange-rate volatility responds to

terms-of-trade shocks. Because commodity prices can affect exports directly for commodity-intensive sectors, their validity depends on the export composition and controls included. For this reason, commodity-price instruments are treated as supplementary and are used primarily in robustness checks rather than as the baseline instrument.

In empirical implementation, instruments are evaluated using standard diagnostics, including first-stage strength (weak-instrument tests) and endogeneity tests (e.g., Wu–Hausman). Where multiple instruments are available, overidentification tests can be used to assess consistency with the exclusion restriction. All instruments are constructed at the annual frequency to match the export and volatility series.

Table 16. External instruments for exchange-rate volatility: construction and validity considerations

Instrument	Construction (annual)	Expected first-stage effect on volatility	Main validity concern / mitigation
ECB policy rate (DFR)	Annual average DFR; use lag (t-1)	Tightening → higher volatility (often)	Could correlate with EU demand/financial cycle → control EU GDP; lag instrument
Global risk (VIX)	Annual average VIX; optional lag	Higher risk → higher volatility	Could also affect exports through global demand → control EU GDP; lag; robustness only if sensitive
Commodity prices (oil/food index)	Annual average index; optional lag	Commodity shocks can raise volatility	May directly affect exports (composition-dependent) → use as robustness; add commodity controls or restrict to non-commodity exports

Sources: Author's compilation based on external macro-financial instrument candidates. ECB policy-rate data refer to the European Central Bank deposit facility rate; global risk is proxied by the CBOE Volatility Index (VIX); and commodity-price instruments may be constructed from World Bank Commodity Price Data ("Pink Sheet"), including energy, oil and food price indices. Instrument construction and validity assessment are developed by the author for the IV strategy applied to Moldova's exchange-rate volatility.

Notes: Instruments are treated as plausibly exogenous with respect to Moldova's exports but may operate through multiple macro channels; results are therefore supported by diagnostics (first-stage strength, endogeneity tests) and robustness checks (alternative instruments and lags), and appropriate controls such as EU GDP or global demand indicators.

Further on, we assess the robustness of the IV results in several ways, including (i) alternative measures of exchange-rate volatility, and (ii) alternative lag structures. As an external-instrument robustness check, we also instrument volatility using **lagged annual-average VIX**, a proxy for global risk appetite.

Table 17 compares IV estimates using the ECB policy-rate instrument against VIX. The VIX first stage is weaker (weak-instrument statistic = 3.18, $p = 0.087$) and the Wu–Hausman test does not indicate endogeneity of volatility ($p = 0.584$). Consistent with this, the VIX-based IV coefficient on volatility is small and statistically insignificant, while the ECB-based specification shows moderate relevance, strong evidence of endogeneity, and a negative (marginally significant) volatility effect. In this application, VIX likely captures broader global conditions that may influence exports through channels other than exchange-rate volatility, weakening identification despite controlling for foreign demand; therefore, we treat VIX-IV as a conservative benchmark rather than the baseline instrument.

Table 17. IV (2SLS) estimates of the effect of exchange-rate volatility on exports: ECB vs VIX instruments (annual)*Panel A. Second stage (2SLS), robust SE (HCl)*

Variable	(1) ECB instrument	(2) VIX instrument
$\ln(FD)$ (EU GDP)	10.512 (2.473) ***	5.564 (1.548) **
Volatility, vol_ann	-0.0136 (0.00728) ·	0.0009 (0.00523)
Constant	-301.76 (73.87) ***	-153.90 (46.16) **

Panel B. Diagnostics

Test	(1) ECB instrument	(2) VIX instrument
Weak instruments	6.667 (p=0.0170)	3.179 (p=0.0872)
Wu–Hausman (endogeneity of volatility)	15.823 (p=0.000685)	0.309 (p=0.5838)
Observations	25	27

Sources: Author's IV/2SLS estimates using annual data for 1997–2024. Moldova's export data are taken from the National Bureau of Statistics of the Republic of Moldova; foreign demand is proxied by European Union GDP from the World Bank World Development Indicators; annual exchange-rate volatility (vol_ann) is constructed by the author from monthly REER data from the National Bank of Moldova; and the external instruments are the lagged annual-average ECB deposit facility rate and the lagged annual-average Cboe VIX index. Robust standard errors are reported.

Notes: Dependent variable is $\ln X_t$. The endogenous regressor is annual exchange-rate volatility (vol_ann). Column (1) instruments volatility with the lagged annual-average ECB deposit facility rate ($ecb\_dfr\_avg\_1l$). Column (2) instruments volatility with lagged annual-average VIX (vix_avg_1l). Robust standard errors are reported in parentheses in Panel A. Both models are exactly identified with one instrument for one endogenous regressor, therefore, overidentification tests are not available. Significance: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, $p < 0.10$.

ECB-based instrumentation provides moderate relevance and strong evidence of endogeneity, yielding a negative (marginally significant) volatility effect, whereas VIX is a weaker instrument and does not support a statistically meaningful volatility effect.

As further sensitivity analysis, we considered alternative volatility measures (rolling-window standard deviation and a forecast-error uncertainty index), alternative lag lengths, and subsamples analyses around major policy and shock episodes; these checks do not materially alter the main conclusions.

Data

This study combines macroeconomic time series and bilateral trade flow data. Annual models use period years **1997–2024**; exchange-rate volatility is estimated from higher-frequency exchange-rate data and then aggregated to annual measures.

I. For the variables the following indicators were used:

1) Exchange rate (MDL/EUR, MDL/USD), Definition. Nominal exchange rates expressed as Moldovan leu (MDL) per unit of foreign currency (EUR and USD).

Frequency and transformation. Official daily rates are aggregated to monthly and/or annual averages. Exchange-rate volatility is estimated using GARCH-family models on higher-frequency data and then annualized.

Source. National Bank of Moldova (official exchange rates).

Export values (total and bilateral). Total exports (annual). Aggregate exports of goods (USD), used in the annual export equations (ARDL/NARDL/IV).

2) Bilateral exports (partner–year panel). Exports by destination country and groups of countries (reported in thousand USD), used to build the partner–year panel for PPML gravity-type models (EU×post2014, EU×post2022, CIS×post2022).

Transformation. Time-series models use log exports (or $\log(1 + X)$ where relevant); PPML models are estimated in levels.

Source. BNS Statbank table “Exports of the Republic of Moldova, structured by countries and groups of countries, 1997–2024” (EXT010200; based on customs declarations).

3) REER, Definition. The real effective exchange rate (REER) is a CPI-based index measuring changes in the real value of Moldova’s currency against a trade-weighted basket of partner currencies and relative prices. The REER series is taken from Bruegel’s “Real effective exchange rates for 178 countries” database (Darvas, 2012), which uses CPI data, nominal exchange rates, and trade weights (including third-market competition).

Frequency and transformation. Annual REER for Moldova is used in logs, $\ln(REER_t)$. In the NARDL specification, $\Delta \ln(REER_t)$ is decomposed into positive and negative partial sums to allow for asymmetric effects.

Interpretation. An increase in CPI-based REER typically indicates real appreciation (lower price competitiveness), while a decrease indicates real depreciation.

Source. Bruegel REER database (Darvas, 2012).

4) Global demand indicators (EU demand proxy). External demand is proxied by **EU27 (from 2020) real GDP level measured in chain-linked volumes (2010), million euro**. The variable is used in logarithms in the annual export equations.

Source. Eurostat national accounts dataset “Gross domestic product (GDP) and main components” (online data code: nama_10_gdp), item **GDP at market prices (B1GQ), unit chain-linked volumes (2010), million euro, geo EU27_2020**, sample period 1997–2024.

5) Domestic production indices, Definition. Industrial Production Index (IPI) capturing real domestic industrial activity (volume index).

Role. Used as a supply-side control where applicable.

Source. BNS Statbank industrial production series (IPI).

6) Instruments / global financial indicators. ECB policy rate (instrument). The instrument is the **ECB deposit facility rate (DFR)**. We use the daily “date-of-changes” series and compute the **annual average**, then use its **one-year lag** as the instrument for annual exchange-rate volatility.

Source. European Central Bank (ECB), Key ECB interest rates / ECB Data Portal (DFR series code: *FM.D.U2.EUR.4F.KR.DFR.LEV*).

II. For Sources the following providers were considered:

- 1) National Bank of Moldova (NBM).** Provides official nominal exchange rates (MDL/EUR, MDL/USD) used to construct exchange-rate returns and volatility measures (GARCH-family models), and to support macro descriptions of exchange-rate dynamics.

- 2) **National Bureau of Statistics (BNS) / Statbank Moldova.** Source for annual export values (total and bilateral by partner and partner-groups, EXT010200) used in PPML gravity-type estimations, and for domestic activity indicators such as the Industrial Production Index (IPI) used as a supply-side control.
- 3) **Bruegel.** Source for Moldova's CPI-based real effective exchange rate (REER) series used in the ARDL/NARDL export equations (Darvas REER database).
- 4) **Eurostat.** Source for external demand indicators, primarily EU27 real GDP level in chain-linked volumes (2010), used as the foreign demand proxy in the annual export equations and the IV specifications.
- 5) **IMF International Financial Statistics (IFS).** Used as a benchmark source for cross-checking macro series (where applicable), and as an optional alternative source for selected exchange-rate and macroeconomic indicators when needed for robustness.
- 6) **UN Comtrade (optional/auxiliary).** Used as a supplementary international trade source for cross-validation and, where needed, alternative partner/product breakdowns; however, the main bilateral export panel in the paper is taken from BNS Statbank.

To stabilize variance and interpret coefficients as elasticities, the main macro variables enter the annual export equations in logarithms (**transformations for Log-levels and growth rates**). In particular, total exports and external demand are used as $\ln X_t$ and $\ln F D_t$, and the real effective exchange rate is used as $\ln(REER_t)$. In the nonlinear specification (NARDL), changes in the REER are defined as $\Delta \ln(REER_t)$ and decomposed into positive and negative partial sums to allow for asymmetric effects. For series that may take zero values in some disaggregations, we use the transformation $\log(1 + X)$ where appropriate. By contrast, PPML gravity-type models are estimated with export flows in **levels** (USD), consistent with the PPML framework and its treatment of zero trade flows.

In these endeavors, seasonal adjustment is relevant primarily for higher-frequency (monthly/quarterly) series. Since the core export equations are estimated on annual data, seasonal adjustment is not required for the main dependent variables. Where monthly exchange-rate data are used to estimate volatility, the volatility models are applied to returns (log differences), which typically do not require seasonal adjustment. If monthly/quarterly trade or production series are used in auxiliary analysis, they can be seasonally adjusted using standard procedures (e.g., X-13ARIMA-SEATS) prior to aggregation.

We need to pay attention to the fact that export values are recorded in nominal USD in the trade datasets. For the annual export equations, the baseline specifications use nominal export values in logs, while controlling for real external demand (EU real GDP) and competitiveness (REER). In such situations, where a real-volume interpretation is required, export values can be deflated using an export price index (unit value index) to obtain real export measures. In the bilateral PPML specifications, the inclusion of year fixed effects absorbs common price-level movements over time; therefore, estimating PPML in levels is standard and does not require deflation for identification of relative partner-group effects.

4. Results and Discussion

This section presents the empirical findings in a structured way. We begin with descriptive statistics and time-series properties of the variables, then report baseline

model estimates and implied elasticities. We subsequently examine dynamic adjustments and heterogeneity, and conclude with robustness checks across alternative specifications and identification approaches.

We report summary statistics for the main variables used in the analysis, including total exports, bilateral exports by destination group, REER, foreign demand (EU real GDP), exchange rates (MDL/EUR and MDL/USD), the estimated annual volatility measure, and domestic production indicators. Descriptive plots (time series and key breaks around 2014 and 2022) are used to motivate the choice of specifications and policy-shock interactions.

Table 18 reports summary statistics for the annual variables used in the export equations. Total exports and external demand are analyzed in logarithms, while REER is used as a log index of competitiveness. The volatility measure shows substantial variation over time, with values ranging from 61.2 to 196.0, motivating the use of regime-based and robustness specifications.

Table 18. Summary statistics (annual series, 1997–2024)

Variable	N	Mean	SD	Min	Max
$\ln FD_t$ (EU27 real GDP, volume level)	28	30.2	0.116	30.0	30.4
$\ln REER_t$ (Bruegel CPI-based REER)	28	4.69	0.297	4.11	5.28
$\ln X_t$ (total exports, USD)	28	14.2	0.660	13.0	15.3
Vol_t (annual exchange-rate volatility)	28	113.0	34.2	61.2	196.0

Sources: Author's calculations based on annual EU27 real GDP chain-linked volume data from Eurostat, CPI-based REER index data for Moldova from the Bruegel real effective exchange rate database, and Moldova's total export data from the National Bureau of Statistics of the Republic of Moldova. Annual exchange-rate volatility (Vol_t) is constructed by the author from REER returns using the GARCH-family volatility estimates. The sample covers 1997–2024.

Notes: $\ln X_t$ is the natural log of total exports (USD). $\ln FD_t$ is the natural log of EU27 real GDP (chain-linked volumes). $\ln REER_t$ is the natural log of the CPI-based REER index. Vol_t is the annualized volatility measure constructed from the GARCH-family model.

To determine the order of integration and guide model choice, we conduct unit root tests for the core annual macro series (exports, REER, foreign demand, and production indices). Standard tests (ADF and/or PP) are used with intercept (and trend where appropriate). Results motivate the ARDL/NARDL framework, which allows variables to be $I(0)$, $I(1)$, or a combination, provided none is $I(2)$.

Table 19. Augmented Dickey–Fuller (ADF) unit root tests (annual data, 1997–2024)
Test regression: drift (intercept); lag length selected by AIC.

Variable	ADF tau statistic (tau2)	1% CV	5% CV	10% CV	Decision (5%)
$\ln X_t$ (exports)	−1.148	−3.58	−2.93	−2.60	Unit root not rejected
$\ln REER_t$	−0.123	−3.58	−2.93	−2.60	Unit root not rejected
$\ln FD_t$ (EU GDP)	−1.262	−3.58	−2.93	−2.60	Unit root not rejected

Sources: Author's own ADF test calculations using annual export data from the National Bureau of Statistics of Moldova, EU27 real GDP data from Eurostat, and CPI-based REER data from Bruegel, 1997–2024.

Note: The null hypothesis of the ADF test is that the variable contains a unit root. The test regression includes an intercept, and the lag length is selected by Akaike Information Criterion (AIC). At the 5% significance level, the ADF statistics do not exceed the critical values in absolute terms; therefore, the unit-root null is not rejected for $\ln X_t$, $\ln REER_t$, and $\ln FD_t$ in levels.

ADF unit root tests with intercept fail to reject the null of a unit root for $\ln X_t$, $\ln REER_t$, and $\ln F D_t$ in levels over 1997–2024. These results suggest that the core macro variables are persistent and likely integrated of order one. This motivates the ARDL/NARDL framework, which accommodates a mix of $I(0)$ and $I(1)$ regressors provided none of the variables is $I(2)$.

Baseline model estimates. Exchange-rate volatility estimation (GARCH family)

We first estimate conditional volatility measures for the exchange rate using GARCH-family models and construct an annual volatility series (Table 20 and 21). Parameter estimates and diagnostic tests are reported, and the resulting volatility series is used as an input in subsequent export models and threshold analysis.

Table 20. EGARCH(1,1) estimates for Moldova monthly REER returns (1997M01–2025M12)

Parameter	Description	Estimate
μ	Mean return	0.003068
ω	Constant (log-variance eq.)	0.000000
α	Magnitude (shock)	0.631453
γ	Asymmetry / leverage	0.036928
β	Persistence	0.980000

Sources: Author's calculations based on monthly Real Effective Exchange Rate (REER) index data for the Republic of Moldova obtained from the National Bank of Moldova. Monthly REER returns were computed as log-differences of the REER index, and the EGARCH(1,1) model was estimated by the author for 1997M01–2025M12.

Note: The dependent variable is the monthly logarithmic return of the REER index. In the EGARCH specification, α captures the magnitude effect of shocks on conditional volatility, γ captures asymmetric or leverage effects, and β measures volatility persistence.

Table 21. TGARCH (GJR-GARCH)(1,1) estimates for Moldova monthly REER returns (1997M01–2025M12)

Parameter	Description	Estimate
μ	Mean return	0.003274
ω	Constant	0.000326
α	ARCH term	0.072772
γ	Threshold (asymmetry)	0.422166
β	GARCH term	0.089230
$\alpha+0.5\gamma+\beta$	Stationarity check	0.373085
LL	Total log-likelihood	842.6394

Sources: Author's calculations based on monthly Real Effective Exchange Rate (REER) index data for the Republic of Moldova obtained from the National Bank of Moldova. Monthly REER returns were computed as log-differences of the REER index, and the TGARCH/GJR-GARCH(1,1) model was estimated by the author for 1997M01–2025M12.

Note: The dependent variable is the monthly logarithmic return of the REER index. The TGARCH/GJR-GARCH(1,1) model captures volatility persistence and possible threshold/asymmetric effects. The stationarity condition is evaluated using $\alpha + 0.5\gamma + \beta$, which equals **0.373085**, indicating a stationary conditional variance process.

We estimate a linear ARDL model and a nonlinear ARDL (NARDL) model to assess the long-run and short-run effects of competitiveness (REER) and external demand (EU GDP) on exports (Table 22 and 23). We report cointegration evidence (bounds tests), short-run dynamics (ECM), and long-run coefficients. The NARDL specification is used to test for asymmetry in appreciation versus depreciation effects.

Table 22. Linear ARDL(1,0,0) results for total exports, Moldova (1997–2024)*Panel A. Bounds test for cointegration (Pesaran et al.)*

Test	Statistic	p-value	Conclusion
Bounds F-test (no cointegration)	7.7114	0.0020	Reject (H_0): cointegration

Panel B. Error-correction model (ECM) estimates

Term	Estimate	Std. Error	p-value
Constant	-70.9477	18.5643	0.000875
$(\ln X_{t-1})$	-0.5015	0.1281	0.000696
$(\ln REER_t)$	0.2200	0.2918	0.4586
$(\ln FD_t)(EUGDP)$	2.5522	0.6542	0.000719

Panel C. Implied long-run elasticities

Variable	Long-run elasticity
$(\ln REER)$	0.4386
$(\ln FD)(EUGDP)$	5.0888

Sources: Author's calculations based on annual total export data for the Republic of Moldova from the National Bureau of Statistics of the Republic of Moldova, CPI-based REER data for Moldova from the Bruegel real effective exchange rate database, and EU27 real GDP data from Eurostat. The linear ARDL(1,0,0), Bounds test, ECM estimates, and implied long-run elasticities were estimated by the author for 1997–2024.

Note: The dependent variable is the logarithm of Moldova's total exports. $\ln REER_t$ denotes the logarithm of the CPI-based Real Effective Exchange Rate index, while $\ln FD_t$ denotes the logarithm of EU27 real GDP, used as a foreign-demand proxy. The Bounds test follows the ARDL cointegration approach of Pesaran, Shin and Smith. The implied long-run elasticities are derived from the estimated ECM coefficients.

Table 23. NARDL results for total exports and REER asymmetry, Moldova (1997–2024)*Panel A. Cointegration (Bounds) tests*

Test	Statistic	Notes
Bounds F-statistic	4.5398	Inconclusive at 10% (above lower bound 4.29, below upper bound 5.08); below 5% lower bound (5.395)
Bounds t-statistic	-3.5440	Significant vs. 10%/5% critical bands; supports cointegration

Panel B. Error-correction (UECM) estimates

Term	Estimate	Std. Error	p-value
Constant	28.3557	8.0735	0.00794
$\ln X_{t-1}$	-2.0946	0.5910	0.00758
$REER_{t-1}^+$	2.9044	0.9118	0.01289
$REER_{t-1}^-$	0.1044	0.7415	0.89156

(Short-run differenced terms are included in the estimation; see notes.)

Panel C. Long-run elasticities and asymmetry tests

Item	Value	p-value
Long-run β^+ (REER increases)	1.3866	<0.001
Long-run β^- (REER decreases)	0.0498	0.8899
Long-run asymmetry (Wald)	11.4406	0.0096
Short-run asymmetry (Wald)	8.2173	0.0209

Panel D. Diagnostics

Test	p-value
Breusch–Godfrey serial correlation	0.9431
ARCH LM	0.9154
Normality	0.6554
RESET	0.4463

Sources: Author's own NARDL estimates using annual data for 1997–2024. Moldova's total export data are taken from the National Bureau of Statistics of the Republic of Moldova; the CPI-based REER series is taken from the Bruegel real effective exchange rate database; and foreign demand is proxied by EU27 real GDP from Eurostat. The positive and negative partial-sum decomposition of REER and the long-run and short-run asymmetry tests are constructed by the author following the NARDL approach of Shin et al. (2014), while the Bounds-testing framework follows Pesaran, Shin and Smith (2001).

Note: The dependent variable is the logarithm of Moldova's total exports. $REER^+$ and $REER^-$ denote the positive and negative partial sums of the REER variable, constructed to test whether REER increases and decreases have asymmetric effects on exports. Long-run and short-run asymmetry are tested using Wald tests. Diagnostic tests report p-values for serial correlation, ARCH effects, normality, and functional-form stability.

Next, using bilateral exports by partner and year, we estimate PPML models with importer and year fixed effects to identify EU-specific shifts after DCFTA (2014) and partner-group differences after the 2022 shock. We report in **Tables 24, 25 and 26** the baseline effects and extensions (EU vs CIS; top vs non-top EU partners).

Table 24. Poisson Pseudo-Maximum Likelihood (PPML) estimates of Moldova's bilateral exports: Deep and Comprehensive Free Trade Area (DCFTA, 2014) and 2022 shock

	(1) Baseline	(2) DCFTA	(3) DCFTA + 2022
EU × post-2014 (eu_post2014)		1.289*** (0.3252)	1.254*** (0.1804)
EU × post-2022 (eu_post2022)			0.0932 (0.6015)
Importer FE (imp_iso3)	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
SE clustered by importer	—	Yes	Yes
Observations	1,064	1,064	1,064
Squared Cor.	0.7890	0.8925	0.8945
Pseudo R ²	0.9111	0.9405	0.9405
BIC	11,718,470.8	7,845,436.6	7,836,126.3

Sources: Author's PPML estimates using Moldova's bilateral export data by partner country from the National Bureau of Statistics of the Republic of Moldova for 1997–2024. The EU × post-2014 variable is constructed by the author to capture the DCFTA period following the provisional application of the EU–Moldova Association Agreement from September 2014, while the EU × post-2022 variable captures the additional post-2022 shock period. The models include importer and year fixed effects, with standard errors clustered by importer. PPML estimation follows Santos Silva and Tenreiro (2006), with high-dimensional fixed effects implemented following Correia, Guimarães and Zylkin (2020).

Note: The dependent variable is Moldova's bilateral exports in levels. The model is estimated by Poisson Pseudo-Maximum Likelihood (PPML). Importer fixed effects control for time-invariant partner-specific characteristics, while year fixed effects control for common shocks affecting all destinations. The post-2014 dummy captures the DCFTA period, and the post-2022 dummy captures the additional shock period after 2022. Standard errors are clustered by importer.

Table 25. 2022 shock heterogeneity (EU vs CIS)

	(1) ppml_both	(2) ppml_shock2
EU × post-2014	0.8435** (0.2931)	0.8427** (0.2927)
EU × post-2022	0.0931 (0.3946)	−0.1464 (0.2824)
CIS × post-2022		−0.3657 (0.6933)
Importer FE	Yes	Yes
Year FE	Yes	Yes
SE clustered by importer	Yes	Yes
Observations	2,032	2,032
Pseudo R ²	0.9287	0.9293

Sources: Author's PPML estimates using Moldova's bilateral export data by partner country from the National Bureau of Statistics of the Republic of Moldova for 1997–2024. The EU × post-2014 variable is constructed by the author to capture the DCFTA period following the provisional application of the EU–Moldova Association Agreement from September 2014, while the EU × post-2022 and CIS × post-2022 variables are constructed to test heterogeneous post-2022 effects across partner groups. The models include importer and year fixed effects, with standard errors clustered by importer.

Note: The dependent variable is bilateral exports in USD levels. Models are estimated by PPML with importer and year fixed effects; standard errors are clustered by importer. EU × post-2022 and CIS × post-2022 measure partner-group-specific deviations after 2022 relative to the omitted group, conditional on year fixed effects, which absorb common shocks. Significance: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table 26. DCFTA effect by top vs non-top EU partners

	(1) ppml_both	(2) ppml_top
EU × post-2014	0.8435** (0.2931)	
Top EU × post-2014		0.8252** (0.3079)
Other EU × post-2014		0.9122** (0.3340)
EU × post-2022	0.0931 (0.3946)	0.0931 (0.3947)
Importer FE	Yes	Yes
Year FE	Yes	Yes
SE clustered by importer	Yes	Yes
Observations	2,032	2,032
Pseudo R ²	0.9287	0.9288

Sources: Author's PPML estimates using Moldova's bilateral export data by partner country from the National Bureau of Statistics of the Republic of Moldova for 1997–2024. The EU × post-2014 variable is constructed by the author to capture the DCFTA period following the provisional application of the EU–Moldova Association Agreement from September 2014. "Top EU" partners are defined by the author as the five EU destinations with the highest average Moldovan exports in the pre-2014 period: Romania, Italy, Germany, Poland and France. The models are estimated with importer and year fixed effects, with standard errors clustered by importer.

Note: The dependent variable is bilateral exports in USD levels. Models are estimated by PPML with importer and year fixed effects; standard errors are clustered by importer. "Top EU" partners are defined as the five EU destinations with the highest average Moldovan exports in the pre-2014 period: Romania, Italy, Germany, Poland and France. Significance: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

We estimate a Hansen-style panel threshold model to evaluate whether the post-2014 EU effect differs across regimes defined by exchange-rate volatility. We report in **Tables 27 and 28** the estimated threshold, regime-specific coefficients, and coefficient-difference tests.

Table 27. Hansen-type panel threshold results (threshold variable: annual volatility)

Item	Result
Threshold variable q_t	Annual volatility (vol_{ann})
Estimated threshold $\hat{\gamma}$	116.366
Dependent variable	$y_{it} = \log(1 + exports_{it})$
Fixed effects	Importer FE + Year FE
SE	Clustered by importer

Sources: Author's own calculations based on Moldova's bilateral export data from the National Bureau of Statistics of the Republic of Moldova and monthly Real Effective Exchange Rate data used to construct annual exchange-rate volatility (vol_{ann}). The estimated threshold $\hat{\gamma} = 116.366$ is obtained from the Hansen-type panel threshold specification, with importer and year fixed effects.

Note: The dependent variable is $y_{it} = \log(1 + exports_{it})$, where iii denotes importer partner and t denotes year. The threshold variable qtq_tqt is annual exchange-rate volatility (vol_{ann}). The estimated threshold $\hat{\gamma} = 116.366$ separates the sample into low- and high-volatility regimes. Standard errors are clustered by importer.

Table 28. Regime-specific DCFTA effect (EU × post-2014):

Coefficient	Estimate	Std. Error	p-value
$EU \times Post2014$ ($lowvol, vol_{ann} \leq \hat{\gamma}$)	1.345	0.652	0.048
$EU \times Post2014$ ($highvol, vol_{ann} > \hat{\gamma}$)	2.184	0.673	0.003

Sources: Author's estimates based on Moldova's bilateral export data by partner country from the National Bureau of Statistics of the Republic of Moldova and the annual exchange-rate volatility variable (vol_{ann}) constructed by the author from REER returns. The $EU \times post-2014$ variable is constructed to capture the DCFTA period following the provisional application of the EU–Moldova Association Agreement from September 2014. Regime-specific DCFTA effects and the high-versus-low volatility difference test are estimated by the author using the Hansen-type panel threshold specification for 1997–2024.

Note: The table reports the estimated DCFTA effect separately for low-volatility and high-volatility regimes, where regimes are defined by the estimated annual volatility threshold $\hat{\gamma} = 116.366$. Standard errors are clustered by importer. The difference test evaluates whether the DCFTA effect differs significantly between the high- and low-volatility regimes. **Difference test:** High – Low = 0.838 (SE 0.235), $t = 3.56$, $p = 0.0013$.

We translate key coefficients into economically interpretable quantities:

- long-run elasticities from ARDL/NARDL,
- percentage effects from PPML interaction terms $(e^{\beta} - 1) \times 100$,
- regime-dependent effects from the threshold model, and discuss magnitudes relative to Moldova's export structure and major policy episodes.

Long-run elasticities are reported directly in **Tables 22 and 23**. PPML implied percentage effects are reported below **Tables 29**, computed as $(e^{\beta} - 1) \times 100$.

Table 29. Elasticities / implied % effects summary

Method	Effect	Estimate	Interpretation
ARDL (long run)	β_{REER}	0.4386	long-run elasticity of exports w.r.t. REER
ARDL (long run)	β_{FD}	5.0888	long-run elasticity of exports w.r.t. EU GDP
NARDL (long run)	β^+ (REER increases)	1.3866	long-run effect of REER appreciations
NARDL (long run)	β^- (REER decreases)	0.0498	long-run effect of REER depreciations (ns)
PPML (BNS bilateral)	$EU \times post2014$	+132.4%	$(e^{0.8435} - 1) \times 100$
PPML (BNS bilateral)	$EU \times post2022$	+9.8%	$(e^{0.0931} - 1) \times 100$ (non-significant)

Method	Effect	Estimate	Interpretation
PPML (BNS bilateral)	EU total post2022	+155.1%	$(e^{0.8435+0.0931} - 1) \times 100$
Threshold (Hansen)	EU×post2014 (low vol)	1.345	effect on $\log(1 + \text{exports})$ when $(\text{vol} \leq \hat{y})$
Threshold (Hansen)	EU×post2014 (high vol)	2.184	effect on $\log(1 + \text{exports})$ when $\text{vol} > \hat{y}$
IV (ECB instrument)	volatility semi-elasticity	-0.0136	effect of (vol_ann) on $\ln X_t$ (marginal)
IV (VIX instrument)	volatility semi-elasticity	0.0009	robustness: insignificant

Sources: Author's synthesis based on own econometric estimates reported in Tables 22–28. Annual ARDL/NARDL estimates use Moldova's total export data from the National Bureau of Statistics of the Republic of Moldova, CPI-based REER data from Bruegel, and EU27 real GDP data from Eurostat. PPML and threshold estimates use Moldova's bilateral export data from the National Bureau of Statistics of the Republic of Moldova, while volatility and IV specifications use author-constructed annual exchange-rate volatility measures and external instruments described in the previous tables.

Note: The table summarizes estimated elasticities, semi-elasticities, and implied percentage effects from the preceding econometric models. PPML percentage effects are calculated as $(e^{\beta} - 1) \times 100$. Threshold coefficients are interpreted as effects on $\log(1 + \text{exports})$ in low- and high-volatility regimes. IV coefficients represent the marginal effect of annual exchange-rate volatility on $\ln X_t$.

Where relevant, we examine adjustment dynamics:

- speed of adjustment from ECM terms;
- short-run multipliers;
- and, if implemented, impulse-response style simulations derived from the estimated ARDL/NARDL models (dynamic multipliers).

Figure 2 plots dynamic multipliers derived from the estimated UECM, showing the adjustment of exports to permanent shocks in foreign demand and competitiveness. A permanent 1% increase in EU real GDP raises exports gradually, converging to a long-run effect of about **5.09%** (after 12 years the simulated response is ~5.22%). A permanent 1% change in $\ln REER$ generates a much smaller long-run response of about **0.44%**, with convergence driven by the error-correction mechanism.

The speed of convergence is governed by the error-correction term ($\phi \approx -0.50$), implying relatively rapid correction of deviations from long-run equilibrium.

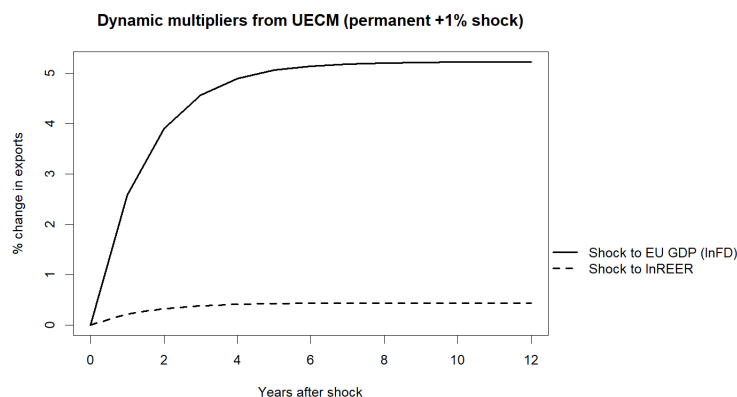


Figure 2. Dynamic multipliers from the estimated ARDL/UECM model

Sources: Author's calculations based on the estimated ARDL/UECM model using annual data for Moldova, 1997-2024.

Note: The figure shows the simulated dynamic response of Moldova's exports to a permanent 1% shock in foreign demand and REER. The vertical axis reports the percentage change in exports, while the horizontal axis shows years after the shock.

Robustness is assessed across several dimensions to ensure that the core conclusions are not driven by a particular specification, sample, or measurement choice.

Alternative lag structures and specifications (ARDL/NARDL). We verify that the main long-run relationships are not sensitive to the chosen lag order by comparing the preferred ARDL/NARDL specification to alternative lag lengths selected by information criteria and to more parsimonious dynamic specifications. The sign and statistical importance of foreign demand remain stable across specifications, while REER effects are weaker in linear models but continue to display asymmetry in NARDL.

Alternative volatility measures and instruments (ECB vs VIX IV). To address potential endogeneity of exchange-rate volatility, we instrument annual volatility using the lagged annual-average ECB deposit facility rate. As a robustness instrument, we also use lagged annual-average VIX. The ECB-based IV shows moderate first-stage relevance and strong evidence of endogeneity (Wu–Hausman), yielding a negative (marginally significant) volatility effect, whereas VIX is a weaker instrument and does not support a statistically meaningful volatility coefficient. This comparison suggests that the volatility effect is sensitive to instrument strength and channel, and is therefore interpreted cautiously.

Alternative partner group definitions (EU/CIS; top partners). In the PPML bilateral panel, we test whether conclusions depend on destination grouping. Adding a CIS×post-2022 interaction does not materially change the post-2014 EU effect and provides no robust evidence of a partner-group-specific break after 2022 beyond common year shocks. Splitting EU destinations into top versus non-top partners (based on pre-2014 export shares) yields positive and similar post-2014 effects, indicating that the EU shift is broad-based rather than concentrated among a small number of destinations.

Subsample analysis around major episodes (post-2014; post-2022). Where feasible, we assess stability by re-estimating key specifications on subperiods aligned with major institutional and shock episodes. The results confirm a strong post-2014 EU reorientation consistent with DCFTA, while post-2022 differentials remain imprecisely estimated once common year effects are controlled for. In particular, re-estimating the PPML model on restricted samples that retain pre-2014 years (2000–2024 and 2005–2024) yields a consistently positive and statistically significant EU×post-2014 coefficient, whereas the EU×post-2022 term remains statistically insignificant, indicating that the baseline findings are not driven by early-sample observations (EU×post-2014 ranges from 0.70 to 0.84 across samples).

5. Conclusions

This paper examined the role of exchange-rate volatility and competitiveness in shaping Moldova's export performance over 1997–2024 using a multi-method empirical framework that combines (i) time-series export equations (ARDL/NARDL), (ii) bilateral partner-level PPML gravity-type models, (iii) a Hansen-style threshold model based on volatility regimes, and (iv) an instrumental-variables strategy to address endogeneity of volatility. Together, these approaches provide complementary evidence on the relative importance of external demand, policy regime shifts, and macro-financial uncertainty for Moldova's export dynamics.

Across specifications, external demand emerges as a key driver of exports. The annual export equations show a strong positive relationship between exports and EU real GDP, while the competitiveness channel is more nuanced: linear REER effects are comparatively weak, but the nonlinear NARDL results indicate asymmetric responses to REER movements, suggesting that appreciations and depreciations can affect exports differently. In the CPI-based REER used here, an increase denotes real appreciation; thus, the NARDL positive component captures appreciations and the negative component captures depreciations. In the bilateral panel, PPML estimates using BNS partner-year export data identify a robust EU-specific shift after 2014, consistent with DCFTA-related trade reorientation. The post-2022 EU differential, however, is not precisely estimated once common year shocks are absorbed by year fixed effects, indicating that the 2022 episode is better characterized as a broad shock rather than a destination-group-specific break.

The analysis also highlights the relevance of macro-financial conditions. The Hansen-type threshold model identifies two volatility regimes and shows that the post-2014 EU effect is significantly stronger in the high-volatility regime, linking export reorientation to periods of elevated uncertainty. Addressing endogeneity, the IV results using the lagged annual-average ECB deposit facility rate as an instrument suggest a negative effect of volatility on exports (marginally significant), while VIX-based instrumentation is weaker and yields an insignificant volatility effect. Taken together, these results are consistent with a dampening role of exchange-rate uncertainty, though the magnitude and statistical precision depend on identification strength.

From a policy perspective, the findings imply that export performance is shaped primarily by external demand conditions and structural market reorientation (particularly toward EU destinations), while competitiveness and volatility channels operate in a more conditional and nonlinear manner. Policies that strengthen export resilience - such as facilitating hedging instruments, improving access to trade finance during high-volatility periods, and supporting diversification across products and destinations - can complement the gains from trade integration. Maintaining macroeconomic credibility and minimizing unnecessary exchange-rate instability remain important for sustaining long-term competitiveness.

The results do not justify recommending a deliberate policy of real depreciation (or appreciation) as a general export-promotion tool. Instead, the evidence supports prioritizing macroeconomic stability and avoiding prolonged real appreciation driven by inflation differentials rather than productivity gains, while enhancing competitiveness through structural measures (productivity, quality upgrading, logistics, and diversification). Given the asymmetric REER responses in NARDL, the export payoff from REER movements appears state-dependent; policy should therefore focus on limiting excessive misalignments and volatility rather than targeting a particular REER direction.

This study has limitations. Data constraints preclude firm-level customs microdata, and annual frequency may mask short-run adjustment dynamics. The IV strategy relies on external instruments whose strength varies across specifications. Future work could extend the analysis using product-level trade panels (HS-based) and sectoral export data, explore micro-level responses through survey or balance-sheet datasets, and refine identification using higher-frequency instruments and event-study designs around policy and shock episodes.

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Table 30. Summary of robustness check

Robustness dimension	Check / alternative specification	Main result tested	Outcome (summary)	Where shown
ARDL/NARDL specification	Alternative lag orders (AIC/BIC); parsimonious ARDL	Stability of long-run demand and REER effects	Foreign demand effect remains stable; REER weak in linear ARDL but asymmetry persists in NARDL	Tables 22 and 23 [NARDL], [ARDL]
Volatility measurement	Alternative GARCH-family volatility (GARCH/EGARCH/TGARCH)	Stability of volatility proxy	Volatility series exhibits comparable dynamics; annualized measure robust to model choice	Tables 1, 2 and 3 [GARCH], [EGARCH/TGARCH]
IV identification	Alternative instrument: ECB DFR (baseline) vs VIX (robustness)	Endogeneity of volatility and sign of volatility effect	ECB-IV: moderate relevance + endogeneity detected; negative (marginal) volatility effect. VIX-IV: weaker first stage, no endogeneity detected, insignificant volatility effect	Table 15, 16 and 17 [ECB vs VIX IV]
Partner-group definition (PPML)	Add CIS×post2022 interaction	2022 differential by partner group	No robust EU- or CIS-specific break in 2022 beyond year effects; DCFTA-era EU effect stable	Table 13 [EU vs CIS shock]
Partner concentration (PPML)	Split EU destinations: top vs non-top EU partners	Whether DCFTA effect is driven by few partners	Post-2014 EU effect remains positive and similar for top and non-top EU partners (broad-based)	Table 26 [Top vs non-top EU]
Subsample stability	Pre/post 2014 and post-2022 subsamples (where feasible)	Stability around major episodes	EU×post2014 remains positive and significant when restricting the sample to 2000–2024 or 2005–2024; EU×post2022 remains insignificant.	Table 9 [Alt start-year PPML]

Sources: Author's synthesis based on the robustness checks and econometric estimates reported in the preceding tables. The robustness exercises use annual and bilateral export data from the National Bureau of Statistics of the Republic of Moldova, REER and volatility measures constructed from REER data, EU27 real GDP data from Eurostat, and external instrument data from the European Central Bank and Cboe VIX. Methodological procedures follow the ARDL/NARDL, GARCH-family, PPML, IV/2SLS, and Hansen-type threshold approaches described in the article.

Note: The table summarizes the main robustness checks used to assess the stability of the empirical results across alternative model specifications, volatility measures, instruments, partner-group definitions, and subsamples. Detailed estimates are reported in the corresponding tables indicated in the final column.

GOVERNING CREDIT WITH DIGITAL TWINS: EXPLAINABLE AI, CREDIT OFFICER DIGITAL TWINS, AND THE EU AI ACT

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Abstract: *The deployment of artificial intelligence in credit decisioning has substantially improved predictive accuracy, yet the opacity of advanced machine learning models raises critical concerns about transparency, fairness, and regulatory compliance. The paper examines the intersection of Explainable AI (XAI), digital twin technology, and the European Union AI Act within the domain of credit origination and underwriting. A conceptual framework is proposed in which a digital twin of the credit deliberation process is complemented by a behavioural Credit Officer Digital Twin, together forming an integrated environment for real-time simulation, multi-level explainability, bias and efficiency monitoring, and regulatory audit. Drawing on recent literature, the paper synthesizes findings on SHAP, LIME, counterfactual explanations, fairness-constrained optimization, and financial and organizational digital twins to argue that twin-enabled XAI architectures can reconcile the tension between model performance, human judgement, and regulatory transparency. The Credit Officer Digital Twin is modelled as a data-driven replica of the human credit officer's decision policy, augmented with analytics that surface individual biases, efficiency patterns, and inconsistencies, thereby supporting meaningful human oversight rather than replacing it. The overall framework operationalizes key requirements of the AI Act for high-risk AI systems, including data governance, documentation, human oversight, and the right to explanation under both the AI Act and the GDPR. Implications for banking practice, supervisory policy, and future research on responsible, human-in-the-loop credit decisioning are discussed.*

Keywords: *Explainable Artificial Intelligence, Credit Scoring, Credit Officer Digital Twin, EU AI Act, Algorithmic Fairness, Responsible AI.*

Classification JEL: E51, O33, C53.

UDC: [004.8:336.77]+[341.1(EU):004.8]

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1. Introduction

Credit decisioning, the process by which financial institutions evaluate, approve, or reject loan applications, has undergone a fundamental transformation in recent years. Traditional statistical methods such as logistic regression and linear discriminant analysis, once the backbone of credit scoring, are increasingly supplemented or replaced by machine learning (ML) algorithms including gradient boosting machines, random forests, and deep neural networks. These models achieve superior predictive performance, reducing default rates and expanding the capacity to assess borrowers with limited credit histories. However, their complexity introduces a fundamental problem: opacity. The very architectures that drive predictive gains - ensemble methods, non-linear transformations, high-dimensional feature interactions - render the decision-making logic inaccessible to human stakeholders, from the borrower denied a mortgage to the compliance officer tasked with audit.

This opacity is not merely an inconvenience. It generates legal, ethical, and operational risks. Borrowers who receive an adverse credit decision are, in many jurisdictions, entitled to an explanation of the factors influencing that outcome. Regulators demand documentation and auditability of models deployed in high-stakes financial decisions. Algorithmic bias - whether inherited from historical data, amplified by feature engineering, or introduced through proxy variables - can produce discriminatory outcomes against protected groups without detection in opaque systems. The European Union's AI Act (Regulation (EU)

2024/1689), which classifies AI systems used for creditworthiness assessment as “high-risk,” imposes stringent requirements for transparency, data governance, human oversight, and ongoing monitoring.

Simultaneously, digital twin technology - the creation of dynamic virtual replicas of physical systems or processes, continuously synchronized with real-time data - has emerged as a powerful paradigm in manufacturing, healthcare, and, increasingly, financial services. Financial digital twins enable institutions to simulate market scenarios, stress-test portfolios, and model operational disruptions in a risk-free environment. Yet the application of digital twin concepts specifically to credit deliberation processes, and to the behaviour of human decision-makers within those processes, remains largely unexplored in the academic literature.

This paper proposes a novel conceptual framework, the Extended Digital Twins for the Credit Deliberation Process (EDT-CDP) in which two types of digital twins are combined: a digital twin of the credit deliberation process (DT-CDP) and a Credit Officer Digital Twin. The DT-CDP models the end-to-end workflow of credit origination and underwriting, integrating Explainable AI methods, algorithmic fairness monitoring, and AI Act compliance mechanisms into a unified simulation and governance architecture. The Credit Officer Digital Twin, by contrast, is conceived as a learning and coaching environment for the human underwriter: a data-driven replica of the officer’s decision policy that continuously learns from their overrides and judgements, makes their heuristics and blind spots explicit, and feeds back tailored insights on bias, consistency, and efficiency. Rather than replacing the human, the twin is designed to help the officer improve over time, by exposing how their decisions compare to model recommendations, institutional policies, and fairness targets, and by providing a safe sandbox in which to experiment with alternative choices without affecting real customers.

The paper addresses different topics: (1) a systematic review of recent literature on XAI techniques applied to credit decisioning; (2) an analysis of the regulatory requirements under the AI Act and GDPR relevant to credit scoring; (3) a conceptual architecture for a DT-CDP that operationalizes explainability, fairness, and compliance by design; and (4) the introduction of the Credit Officer Digital Twin as a coaching-oriented construct for analysing and augmenting human decision-making in credit underwriting.

2. Literature Review

The growing use of AI in credit scoring is marked by a persistent tension between predictive accuracy and interpretability. Advanced models such as XGBoost, LightGBM, and deep neural networks can outperform traditional approaches like logistic regression by capturing complex, non-linear feature interactions, but they often do so at the cost of transparency. As Barredo Arrieta et al. (2020) note, explainability concerns the ability to render the internal logic of AI systems understandable to human users, a distinction that is particularly important in credit decisioning, where borrowers, regulators, and institutions must understand not only the outcome but also the reasons behind it.

Recent studies suggest that this trade-off is no longer absolute. Ogbuefi et al. (2025) show that post-hoc XAI techniques can be integrated into high-performing credit models without materially undermining predictive performance, while comparative research highlights the complementary strengths of SHAP and LIME. SHAP, introduced by Lundberg and Lee

(2017), offers theoretically grounded and relatively stable explanations suitable for audit and risk management, whereas LIME, proposed by Ribeiro, Singh, and Guestrin (2016), provides simpler local explanations that may be easier to communicate to customers and loan officers, albeit with greater instability. Pathi and Pothineni (2025) therefore argue for hybrid approaches capable of serving different stakeholder needs within the same credit pipeline. Beyond feature attribution, counterfactual explanations further enrich the XAI toolkit by showing applicants the minimal changes that could have led to a different outcome. Wachter, Mittelstadt, and Russell (2018) frame these explanations as particularly relevant for transparency, contestability, and recourse, and Takahashi, Shimizu, and Tanaka (2024) refine this logic through causal methods that avoid unrealistic recommendations. In the credit domain, Prade (2022) places counterfactual and recourse generation within a broader explanatory pipeline that also includes bias auditing and continuous monitoring.

Yet the literature also makes clear that explainability remains far from straightforward. Post-hoc methods can suffer from instability, infidelity, multiplicity, and stakeholder misalignment: LIME may generate different explanations for nearly identical cases (Pathi and Pothineni, 2025; Prade, 2022), surrogate explanations may diverge from the true decision logic (Barredo Arrieta et al., 2020; Sowmiya et al., 2024), multiple narratives may be constructed around the same prediction, and technically sound explanations may still fail to satisfy borrowers or compliance officers. The issue, then, is not simply to “add” explanation to AI-based credit scoring, but to embed explanation within a broader governance structure capable of supporting transparency, consistency, and practical accountability.

This need becomes even more pressing under the current European regulatory framework. The EU AI Act (Regulation (EU) 2024/1689) explicitly classifies AI systems used to assess the creditworthiness of natural persons as high-risk, thereby imposing obligations related to risk management, data governance, documentation, logging, transparency, human oversight, and robustness. Hacker and Eber (2025) emphasize that the scope of the Act is broad enough to include not only sophisticated machine learning models but also more conventional decisioning systems, extending regulatory exposure across much of the lending sector. In parallel, the GDPR and the AI Act together strengthen the right to explanation: under the GDPR, individuals are entitled to meaningful information about the logic involved in automated decisions, while Article 86 of the AI Act requires clear and meaningful explanations of the AI system’s role and the main elements of the decision. Juliussen (2025) and Metikos and Ausloos (2025) show, however, that translating these legal principles into operational practice remains challenging, especially when explanations are unstable, overly technical, or insufficiently tailored to different audiences. Similar concerns arise in relation to algorithmic fairness.

Article 10 of the AI Act, together with broader non-discrimination principles in EU law, requires that credit scoring systems do not produce systematically biased outcomes. Nagaraj (2025) demonstrates that fairness constraints can be incorporated directly into model optimization, although this also reveals the well-known difficulty that fairness criteria may conflict with one another. Sowmiya et al. (2024), Barredo Arrieta et al. (2020), Pathi and Pothineni (2025), and Prade (2022) further show that biased data, problematic feature engineering, unstable explanations, and stakeholder misalignment can together obscure rather than reduce discrimination. It is in response to this combination of technical opacity, legal obligation, and governance complexity that digital twin technology becomes particularly relevant.

Defined by Grieves (2014) and expanded by Grieves and Vickers (2017) as a dynamic virtual representation continuously synchronized with real-world data, digital twins have already found applications in banking for stress testing, fraud detection, credit strategy simulation, and infrastructure resilience. Pattabhi (2025) conceptualizes these as Financial Digital Twins, while Chatterjee et al. (2024), FICO's Business Outcome Simulator, Lloyds Banking Group, and BCG's Tech in Banking 2025 report illustrate their growing practical relevance. Nevertheless, the existing literature remains focused on portfolio risk, operational systems, and fraud, rather than on the credit deliberation process as a governed socio-technical workflow. No published study, to the knowledge reflected in the present review, has proposed a digital twin specifically designed to replicate and govern the full sequence from application intake to scoring, human review, final decision, explanation, and audit. It is precisely this gap that the present paper addresses.

3. Methodology

The proposed Extended Digital Twins of the Credit Decision Process (EDT-CDP) is a layered architecture consisting of six interconnected modules:

1. **Process Replication Layer:** A dynamic model of the entire credit deliberation workflow - data collection, scoring, policy rule application, human deliberation, decision output, and client communication. This layer mirrors the real-world process in real time, capturing decision flows, timing, exceptions, and overrides.
2. **XAI Engine:** An integrated module that generates multi-stakeholder explanations for each credit decision. The engine combines:
 - SHAP-based global and local explanations for audit and risk management;
 - LIME-based local explanations for customer-facing communication;
 - Counterfactual explanations for applicant recourse, describing the minimal changes that would alter the decision.
3. **Fairness Monitoring Module:** A continuous bias auditing system that evaluates model outputs across protected attributes (gender, ethnicity, age, geography) using multiple fairness metrics (demographic parity, equal opportunity, equalized odds). Alerts are triggered when disparities exceed predefined thresholds, and the module tracks fairness metrics over time to detect drift.
4. **Scenario Simulation Engine:** A sandbox environment where credit policy changes, model updates, macroeconomic shocks, or regulatory changes can be simulated before deployment. Users can test the impact of introducing ESG criteria into credit policy, adjusting risk thresholds, or deploying a new ML model, observing projected effects on approval rates, default rates, profitability, and fairness metrics.
5. **Compliance and Audit Layer:** An automated module that generates regulatory documentation aligned with AI Act requirements: technical documentation (Article 11), logging and record-keeping (Article 12), transparency notices (Article 13), and human oversight protocols (Article 14). This layer maintains a tamper-proof audit trail of every decision, explanation, and intervention.

6. Credit Officer Digital Twin: A complementary module that models the human credit officer as a data-driven, dynamic behavioural twin, continuously updated through observed decisions and contextual information. It captures decision thresholds, override patterns, and feature sensitivities, while producing bias and efficiency analytics and delivering feedback that strengthens consistency, learning, and meaningful human oversight.

The EDT-CDP operationalizes explainability at three levels, corresponding to different stakeholders and AI Act requirements:

- Level 1 – Applicant-facing explanations: When a credit application is rejected (or approved with conditions), the DT-CDP automatically generates a plain-language explanation drawing on LIME-based local attributions and counterfactual statements. Example: "Your mortgage application was not approved. The main factors were: (1) your current debt-to-income ratio of 48%, which exceeds our threshold of 40%; (2) your employment tenure of 8 months, which is below the 12-month minimum for this product. If your debt-to-income ratio were reduced to 40% or below, the decision would change to approval." This fulfills the AI Act Article 86 requirement for "clear and meaningful explanations".
- Level 2 – Underwriter and risk management explanations: The XAI engine provides SHAP-based feature attributions at both individual and portfolio levels, displayed through an explainability dashboard. Underwriters can inspect the contribution of each variable to a specific decision, compare it against the portfolio distribution, and identify cases requiring manual review. This supports the AI Act's human oversight requirement (Article 14).
- Level 3 – Regulatory and audit explanations: The compliance layer generates structured reports documenting model logic, training data characteristics, performance metrics, fairness audit results, and a complete decision log with associated explanations. These reports are designed to meet the technical documentation requirements of the AI Act (Articles 11–12) and can be produced on demand for supervisory inspections.

While the DT-CDP models the end-to-end credit deliberation process, a complementary construct is the credit officer digital twin: a data-driven, dynamic virtual replica of a human credit officer's decision-making behaviour, continuously updated from observed decisions and contextual information. Rather than merely approximating model outputs, the twin learns the officer's implicit decision policy, including typical approval and rejection thresholds, patterns of manual overrides of model recommendations, and sensitivity to specific features such as employment stability, collateral quality, or ESG-related flags.

Building on emerging work on digital twins for human capital and organizational decision-making, the credit officer digital twin serves not only as a mirror but as an augmented decision support entity. On top of the behavioural profile, the twin incorporates analytics modules that estimate (i) bias indicators (for example, disparities in approval rates across demographic or geographic segments after controlling for risk-relevant variables), and (ii) efficiency metrics (such as time spent per case, intra-officer consistency on similar applications, and divergence from institution-wide policies). In operation, the twin can provide the officer with real-time feedback - highlighting when a current decision deviates from their usual pattern, from the model's recommendation, or from fairness and consistency targets - and in simulation mode it

allows the institution to explore how changes in policies, training, or incentives would reshape individual decision behaviour. This conception aligns with the AI Act's emphasis on meaningful human oversight: the officer remains in the loop, but is systematically augmented by a digital environment that surfaces their own blind spots, biases, and efficiency gaps, thereby improving both individual judgement and institutional governance.

4. Results and Discussion

The EDT-CDP framework contributes to the literature by reframing explainability in credit scoring from a predominantly model-centric problem to a broader question of socio-technical governance. Much of the existing XAI literature has concentrated on the interpretability of individual predictions, while the digital twin literature has focused on simulation, synchronization, and process optimization at the system level. The contribution of the present framework lies precisely in integrating these two perspectives. Rather than treating explanation as an add-on to an otherwise opaque model, the EDT-CDP embeds explainability within the architecture of the credit deliberation process itself, where model outputs, human intervention, fairness controls, and audit requirements are connected within a continuously updated digital environment. This shift is theoretically important because many of the problems identified in the credit-XAI literature - instability of post-hoc explanations, weak alignment with stakeholder needs, and limited integration with organizational routines - cannot be fully resolved through model-level interpretability alone. They require a governance structure capable of situating explanations within the wider institutional, procedural, and regulatory context in which credit decisions are made.

A second contribution lies in the framework's explicit operationalization of the AI Act's requirements for high-risk credit systems. Existing approaches often conceptualize compliance as an external layer added after model development, typically through documentation, validation procedures, or isolated explanation tools. By contrast, the EDT-CDP translates transparency, human oversight, fairness monitoring, logging, and documentation into native functions of the decision infrastructure. In doing so, it advances a compliance-by-design logic that is especially relevant for banking, where legal exposure increasingly depends not only on predictive performance but also on the demonstrability of traceability, contestability, and institutional control. This gives the framework significance beyond the technical domain of explainable AI: it also speaks to the growing policy debate on how high-risk AI systems should be governed in practice. The framework suggests that regulatory alignment is unlikely to be achieved through fragmented controls or ex post justification alone; instead, it requires integrated architectures in which explanation, monitoring, and accountability are built into the operational fabric of decision-making. In this sense, the EDT-CDP offers a conceptual bridge between the legal language of the AI Act and the organizational realities of model deployment in financial institutions.

A third and more original contribution is the introduction of a multi-level and multi-stakeholder logic of explanation within a digital twin environment. Prior research has repeatedly shown that explanations are not universally meaningful: what is useful for a model validator may be unintelligible to a borrower, while a borrower-oriented explanation may be too superficial for supervisory or audit purposes. The EDT-CDP addresses this limitation by conceptualizing explanation as a differentiated governance function rather than as a single output. Explanations become context-sensitive artifacts tailored to the

informational role of the recipient: recourse-oriented and plain-language explanations for applicants, model-based and portfolio-level insights for underwriters and risk managers, and structured traceability for auditors and regulators. This layered approach is important because it aligns explainability with institutional plurality rather than technical uniformity. It also reinforces the idea that the legitimacy of AI-supported credit decisioning depends not merely on whether an explanation can be generated, but on whether the explanation is appropriate, stable, and actionable for the audience that receives it.

From a managerial standpoint, the EDT-CDP offers financial institutions a credible response to a set of pressures that are often perceived as mutually constraining. Banks increasingly rely on complex machine learning models to enhance predictive accuracy and expand credit assessment capabilities, yet these same models intensify demands for transparency, fairness, and human accountability. The framework indicates that these objectives need not be treated as irreconcilable trade-offs if they are addressed through an integrated governance architecture. By combining XAI, fairness monitoring, simulation capabilities, and compliance functions in a single environment, the EDT-CDP allows institutions to move from reactive compliance - where explanations are generated only after a decision is challenged - to proactive governance, in which decision processes are explainable, reviewable, and auditable by construction. This proactive orientation is particularly relevant in credit markets, where reputational risk, litigation risk, supervisory scrutiny, and public concerns about discrimination increasingly converge. In such settings, the ability to demonstrate not only model validity but also procedural fairness and oversight quality becomes a strategic capability rather than a mere compliance obligation.

The framework also has important implications for organizational learning and resilience. One of the main limitations of conventional XAI tools is that they are largely retrospective: they help explain what happened in a given case, but they do not necessarily help institutions understand how future decisions may evolve under changing policies, data conditions, or macroeconomic shocks. The digital twin logic extends the role of explainability from retrospective justification to anticipatory governance. Through simulation, the institution can assess ex ante how changes in thresholds, policy rules, model updates, ESG criteria, or external market conditions may affect approval rates, fairness profiles, operational bottlenecks, and the stability of explanations themselves. This capability is significant because it repositions governance from a defensive function to a strategic one. Rather than merely documenting or correcting problematic outcomes after deployment, banks can test interventions before they affect real customers, thereby reducing operational and ethical risk while strengthening adaptive capacity.

More broadly, the EDT-CDP contributes to the discussion on human oversight by challenging minimalist interpretations of the “human in the loop” principle. In many real-world settings, human oversight is reduced to a formal possibility of override, without ensuring that the human actor is actually equipped to understand the model’s logic, detect problematic outputs, or recognize their own biases. The framework suggests that meaningful oversight requires a richer informational infrastructure, one that makes model outputs interpretable, deviations visible, trade-offs explicit, and interventions traceable. In this respect, the EDT-CDP redefines oversight not as a procedural formality but as an organizational capability supported by technical design.

This is particularly relevant when considered alongside the complementary role of the Credit Officer Digital Twin, which further extends the governance logic from process replication

to the augmentation of human judgment itself. Taken together, these elements point toward a broader reconfiguration of AI governance in credit decisioning: one in which explainability, fairness, simulation, and human oversight are not separate compliance tasks, but interdependent dimensions of a coherent institutional architecture.

5. Conclusions

The convergence of Explainable AI, digital twin technology, and the EU AI Act marks an inflection point for the credit industry - one that demands not incremental adjustment but a fundamental rethinking of how AI-powered decisions are governed. This paper has argued that standalone ML models and ad-hoc XAI tools, however sophisticated individually, are structurally insufficient to meet the transparency, auditability, fairness, and human oversight requirements that the AI Act now imposes on high-risk credit scoring systems. The proposed Extended Digital Twins of the Credit Deliberation Process (DT-CDP), complemented by the Credit Officer Digital Twin (CODT), represents a shift in conceptual register: from explaining decisions after the fact to governing the entire deliberation process by design.

The framework makes three contributions that extend beyond its specific application domain. Theoretically, it bridges the XAI and digital twin literatures - fields that have developed largely in parallel - by embedding model-level explanation methods within a process-level simulation and governance architecture. This integration responds directly to documented failures of isolated XAI tools: the instability of local surrogate explanations, the misalignment between technical outputs and the needs of borrowers and auditors, and the disconnect between model performance metrics and the broader governance of the institutions deploying those models. Practically, the DT-CDP offers a compliance-by-design path for financial institutions navigating the AI Act's obligations for high-risk systems, transforming regulatory requirements from a checklist exercise into an embedded feature of operational infrastructure. The CODT introduces an additional dimension largely absent from existing governance frameworks: the systematic augmentation of human judgment, surfacing individual biases and inefficiencies not to discipline or replace human decision-makers, but to support the kind of meaningful oversight that the AI Act explicitly requires.

Several limitations must be acknowledged. The framework remains conceptual; empirical validation through implementation in a real banking environment is necessary to assess feasibility, cost, and operational performance. The computational demands of maintaining a real-time digital twin with integrated SHAP and counterfactual generation at scale may be substantial, requiring further research into efficient approximation methods that preserve explanation quality without prohibitive infrastructure costs. The framework also assumes the availability of high-quality, structured data flows from the physical credit process to the digital twin - an assumption that may not hold in institutions with fragmented or legacy IT architectures, where integration costs could prove a significant barrier to adoption.

Future research should pursue four directions. First, empirical pilots of EDT-CDP implementations in banking environments would provide the evidence base needed to move from conceptual proposal to operational recommendation, measuring the impact on explanation quality, bias reduction, and regulatory compliance cost. Second, federated learning approaches merit investigation as a means of enabling digital twins to share insights and calibrate fairness metrics across institutions without transferring sensitive borrower data - a mechanism that could accelerate the development of sector-wide governance standards.

Third, as AI Act implementing regulations evolve, research into standardized explanation templates and fairness metrics aligned with regulatory expectations would reduce compliance uncertainty and enable more consistent cross-institutional comparison. Fourth, the emergence of generative AI methods capable of producing natural-language summaries from SHAP and LIME outputs opens the possibility of dynamically tailoring explanations to the cognitive and informational needs of specific audiences - borrowers, underwriters, and supervisors alike - a direction that could substantially close the gap between technical explainability and the legal standard of "meaningful" explanation.

As the AI Act's compliance timeline for high-risk AI systems approaches its operational threshold in August 2026, financial institutions face a choice: continue treating explainability as an afterthought, patching opaque systems with post-hoc tools, or embed responsible AI governance at the core of credit decisioning. The EDT-CDP framework offers a blueprint for the second path - one in which regulatory compliance is not a burden to be minimized but a source of institutional resilience, decision quality, and ultimately competitive advantage.

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REGULATORY FRAMEWORKS FOR INNOVATION AND COOPERATIVE DEVELOPMENT

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Abstract: *A robust national regulatory and strategic framework plays a crucial role in fostering research, innovation, and sustainable economic development. This paper analyzes the extent to which national policies in the Republic of Moldova support innovation and entrepreneurship, with a particular focus on the positioning of cooperative enterprises within the innovation ecosystem. The study is based on a qualitative methodological approach, relying on the documentary analysis of key legislative and strategic documents, complemented by a comparative and interpretative perspective. The findings reveal that Moldova has developed a relatively complex policy framework aimed at promoting a knowledge-based economy, including the National Programme in the fields of research and innovation for 2024–2027, which emphasizes institutional capacity building, technology transfer, and integration into the European Research Area. However, the results indicate that the effectiveness of these policies is constrained by insufficient coherence, weak interconnections between research and business sectors, and limited operationalization of policy instruments. A significant gap identified by the study concerns the limited integration of cooperatives into innovation and entrepreneurship policies, including those targeting small and medium-sized enterprises. Additionally, although the concept of smart specialization is recognized at the strategic level, its practical implementation remains underdeveloped. The paper concludes that enhancing policy integration, strengthening implementation mechanisms, and explicitly incorporating cooperative enterprises into innovation strategies are essential for improving economic resilience, fostering inclusive growth, and supporting sustainable development.*

Keywords: *Regulatory framework, Innovation systems, Cooperative enterprises, Entrepreneurship, Smart specialization, Economic resilience.*

Classification JEL: O31, O32, O38, R58, R11.

UDC: [004.8:336.77]+[341.1(EU):004.8]

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1. Introduction

In the context of global economic transformations, characterized by accelerated digitalization, globalization, and the increasing complexity of the competitive environment, innovation is widely recognized as a key driver of competitiveness and sustainable development. The specialized literature emphasizes the decisive role of the regulatory framework and public policies in stimulating research, technological development, and entrepreneurial activities, considering them essential instruments for strengthening economic resilience.

At the same time, the cooperative model is addressed in economic literature as an effective mechanism for promoting economic inclusion and community development. However, existing research highlights a limited integration of cooperatives into innovation ecosystems, particularly in emerging economies, where regulatory policies are not always aligned with strategic development objectives.

The research problem of this paper consists in analyzing the extent to which the national regulatory framework contributes to fostering innovation and the development of cooperatives, as well as in identifying its level of integration within current economic and strategic policies. In this context, the main objective of the study is to assess the regulatory

framework from the perspective of its capacity to support innovation and the development of entrepreneurial and cooperative ecosystems.

The scientific approach is focused on examining the mechanisms through which public policies stimulate innovation and entrepreneurial development, while also highlighting the role of cooperative enterprises within innovation policies. Furthermore, the research aims to identify opportunities for integrating modern strategic instruments, such as smart specialization, into the existing regulatory framework, in order to enhance policy efficiency and direct innovation toward priority areas.

The research hypothesis is based on the premise that, although the national regulatory framework provides instruments for supporting innovation and economic development, its effectiveness is limited by the lack of coherence and integration between innovation policies, entrepreneurship policies, and the cooperative legal framework.

The methodology employed is based on the documentary analysis of legislative and strategic frameworks, complemented by a comparative and interpretative approach to relevant public policies, which allows for highlighting the interdependencies between regulation, innovation, and cooperative development.

Preliminary results indicate the existence of significant opportunities for the development of cooperatives through innovation policies, as well as structural gaps related to the coherence and implementation of the regulatory framework.

The significance of the study lies in emphasizing the need for an integrated approach to public policies in order to strengthen economic resilience, promote sustainable development, and fully capitalize on the potential of cooperatives within the modern economy.

2. Literature Review

The analysis of the specialized literature highlights the decisive role of the regulatory framework and public policies in fostering innovation, entrepreneurial development, and the consolidation of economic ecosystems (Foray, 2014; Şavga, 2024). In the case of the Republic of Moldova, this framework is structured through a coherent set of legislative acts and strategic documents aimed at supporting research, innovation, digitalization, and business development.

The foundation of the regulatory framework in the field of research and innovation is provided by the Code on Science and Innovation (Parliament of the Republic of Moldova, 2004), which regulates the organization and functioning of the national research and development system. This is complemented by the Education Code (Parliament of the Republic of Moldova, 2014), which contributes to the development of human capital and to the integration of education with research and innovation. At the same time, documents such as the National Programme in the Fields of Research and Innovation (Government of the Republic of Moldova, 2023c) and its related implementation plans define priority directions and support mechanisms for innovative activities.

At the strategic level, economic development is guided by documents such as the National Development Strategy “European Moldova 2030” (Parliament of the Republic of Moldova, 2022), the Digital Transformation Strategy of the Republic of Moldova for 2023–2030 (Government of the Republic of Moldova, 2023a), and the National

Development Plan 2024-2026 (Government of the Republic of Moldova, 2023b), which promote economic modernization, digitalization, and increased competitiveness. These documents reflect a clear orientation toward European integration and the consolidation of a knowledge-based economy.

Entrepreneurial development is supported by Law No. 179/2016 on small and medium-sized enterprises (Parliament of the Republic of Moldova, 2016), which aims to stimulate private initiative and create a favorable business environment. At the same time, innovation infrastructure is regulated by Law No. 182/2010 on industrial parks (Parliament of the Republic of Moldova, 2010) and Law No. 226/2018 on science and technology parks and innovation incubators (Parliament of the Republic of Moldova, 2018), which represent important instruments for facilitating technology transfer and developing innovation ecosystems. These regulatory instruments provide the institutional framework necessary for supporting innovation activities, fostering cooperation between research organizations and businesses, and enhancing the commercialization of research results.

A relevant theoretical concept in contemporary literature is smart specialization, developed by Foray (2014), which emphasizes the need to concentrate resources in priority areas based on the competitive advantages of the economy. This concept is embedded in European policies and represents a key instrument for stimulating innovation and enhancing competitiveness.

Regarding the cooperative sector, the literature highlights its role in promoting economic inclusion, local development, and sustainability. Studies conducted by Şavga (2019, 2024, 2025) emphasize the importance of consumer cooperatives in the context of European integration, resilience, and sustainable development, as well as the need to adapt cooperative enterprises to the requirements of the modern economy. The importance of participation, collaborative governance, and stakeholder involvement in cooperative organizations has also been highlighted in international studies. According to Buang and Abu Samah (2021), active member participation and effective governance mechanisms contribute significantly to the sustainability and performance of cooperative enterprises.

However, the literature analysis reveals a gap between the existing regulatory framework and the practical valorization of the potential of cooperatives within innovation ecosystems (Şavga, 2024; Şavga, 2025).

Although a well-defined legislative and strategic framework exists, the integration of cooperatives into innovation policies and economic development instruments remains limited. In this context, the present research aims to contribute to the existing literature through an integrated approach to the regulatory framework, by analyzing the interdependencies between innovation policies, entrepreneurship, and cooperative development, as well as the role of modern strategic instruments in strengthening these relationships.

3. Methodology

This research adopts a qualitative approach, aiming to analyze the regulatory and strategic framework governing innovation, entrepreneurship, and cooperative development in the Republic of Moldova. The choice of this approach is justified by the complexity of the topic, which requires the interpretation and correlation of an extensive body of legislative and strategic documents.

The main method employed is documentary analysis, which involves the systematic examination of relevant legal acts and public policy documents. The research includes the analysis of key legislative acts, such as the Code on Science and Innovation, the Education Code, legislation on small and medium-sized enterprises, as well as regulations related to innovation infrastructure, including industrial parks and innovation incubators.

In addition, the analysis encompasses national strategic documents, such as the National Development Strategy “European Moldova 2030”, the Digital Transformation Strategy, the National Development Plan 2024-2026, and national programs in the field of research and innovation. These documents were examined in order to identify priority development directions and the instruments used to stimulate innovation and economic competitiveness.

The documentary analysis is complemented by a comparative and interpretative approach, which allows for assessing the degree of coherence, complementarity, and integration of public policies. This method facilitates the identification of relationships between different components of the regulatory framework and highlights their impact on the development of entrepreneurial and cooperative ecosystems.

The research also incorporates elements of conceptual analysis, through the use of relevant theoretical concepts such as innovation, economic resilience, and smart specialization, which support the interpretation of findings within the current context of economic development.

The research process included the following stages: identification and selection of relevant sources, content analysis of normative and strategic documents, systematization of information, and interpretation in relation to the research objectives and hypothesis. This methodological approach ensures scientific rigor and allows for the reproducibility of the analytical process.

At the same time, the study has certain limitations, generated by the predominantly qualitative nature of the analysis and its reliance on official documentary sources. In this regard, the results primarily reflect the formal regulatory framework and may be further complemented in future research through empirical methods or case studies.

Overall, the adopted methodology provides an appropriate framework for the complex analysis of the relationships between regulation, innovation, and cooperative development, contributing to highlighting the role of the regulatory framework in supporting sustainable economic development.

4. Results and Discussion

The analysis of the regulatory and strategic framework in the Republic of Moldova reveals that, over the past decade, a relatively complex system of regulations has been developed to support economic growth based on research, innovation, and entrepreneurship. This evolution reflects a clear strategic orientation toward the transition to a knowledge-based economy, supported by a broad set of legislative acts and policy documents aimed at strengthening human capital, fostering innovation processes, and enhancing overall economic competitiveness. At the same time, this framework demonstrates an increasing alignment with European development directions, particularly in terms of digitalization, innovation-driven growth, and sustainable development.

The foundation of the regulatory framework in the field of research and innovation is established by the Code on Science and Innovation No. 259/2004 (Parliament of the Republic of Moldova, 2004), which enshrines the strategic importance of scientific research and technological development in socio-economic progress. The provisions of this legal act emphasize the necessity of valorizing scientific knowledge and transforming research outcomes into competitive products and services capable of contributing to economic growth. In addition, the Education Code No. 152/2014 (Parliament of the Republic of Moldova, 2014) reinforces the role of the education system as a fundamental pillar of sustainable development, ensuring the formation of human capital and creating the institutional conditions necessary for integrating research and innovation activities within higher education institutions.

Despite these formal provisions, the analysis highlights a limited degree of coordination between the academic environment and the business sector, particularly in relation to technology transfer mechanisms. The insufficient development of structured cooperation channels between universities, research organizations, and enterprises constrains the practical capitalization of research results and weakens the functioning of the knowledge triangle (education-research-innovation). This gap indicates that, although the institutional framework exists, its operational effectiveness remains constrained by weak interconnections among its components.

With regard to entrepreneurial development, the national regulatory framework places particular emphasis on supporting micro, small, and medium-sized enterprises (SMEs), which are widely recognized as a key driver of economic growth, employment creation, and adaptability to technological changes. Law No. 179/2016 on SMEs (Parliament of the Republic of Moldova, 2016) aims to enhance their competitiveness and performance while facilitating their integration into a dynamic and innovation-oriented economic environment. The law explicitly encourages innovation and technology transfer by introducing a range of support instruments designed to strengthen the innovative capacity of enterprises.

Among these instruments are measures aimed at facilitating the adoption of new technologies and products, supporting internal research and development activities within SMEs, and promoting the development of innovation-related competencies. Additionally, the legal framework provides for the development of innovation infrastructure, including science and technology parks, business incubators, research laboratories, production platforms, and information and consultancy centers. These elements are intended to create a supportive ecosystem for innovation and to facilitate interaction between different actors involved in the innovation process.

The law also includes financial support mechanisms such as credit guarantee schemes for SMEs, improved access to financing, incentives for attracting capital investments, including through business angel investors, and the provision of fiscal facilities. These instruments are designed to reduce financial barriers and encourage entrepreneurial initiative, particularly in sectors with high innovation potential.

However, the analysis indicates that the effectiveness of these instruments is constrained by insufficiently developed implementation mechanisms and by the lack of strong functional integration between innovation policies and entrepreneurial development policies. In particular, the mechanisms governing interaction between the research sector and the business environment in terms of technology transfer remain insufficiently defined.

Furthermore, the innovation component is not adequately reflected in the objectives of state programs dedicated to SME development, which limits the ability of enterprises to actively participate in innovation ecosystems and to benefit from research outcomes.

The regulatory framework governing innovation infrastructure, including industrial parks and science and technology parks, provides a favorable institutional basis for supporting technological development and the valorization of research results. Nevertheless, the practical utilization of these instruments remains below their potential, primarily due to their limited integration into broader economic policies and the absence of effective coordination mechanisms among responsible institutions.

At the strategic level, national policy documents such as the “European Moldova 2030” Strategy (Parliament of the Republic of Moldova, 2022), the Digital Transformation Strategy of the Republic of Moldova 2023-2030 (Government of the Republic of Moldova, 2023a), and the National Development Plan 2024–2026 (Government of the Republic of Moldova, 2023b) outline key directions for modernization, digitalization, and sustainable economic development. These strategies reflect a long-term vision aligned with European integration objectives and the transition toward a more competitive and innovation-driven economy. However, the analysis shows that the objectives formulated in these documents are often general in nature and not sufficiently linked to concrete priorities in research and innovation. This limits the effectiveness of resource allocation and reduces the measurable impact of public policies on economic transformation.

In this context, the concept of smart specialization (Foray, 2014) becomes particularly relevant as a strategic tool for guiding innovation toward priority domains with high competitive potential. Developed within the European policy framework, smart specialization emphasizes the need to concentrate resources in areas where economies possess comparative advantages. Although this concept is acknowledged in national strategic documents, its practical implementation in the Republic of Moldova remains limited. This is mainly due to the absence of clearly defined priority domains and the lack of operational mechanisms for implementation, monitoring, and evaluation. As a result, the potential benefits of concentrating resources and developing specialized value chains are not fully realized.

An important dimension of the analysis concerns the cooperative sector, which, despite its significant potential for fostering economic inclusion and supporting local development, remains insufficiently integrated into innovation ecosystems. Cooperatives operate under a distinct regulatory framework governed by the Law on Consumer Cooperation No. 1252/2000 (Parliament of the Republic of Moldova, 2000). From an economic perspective, however, they can be considered associative entities closely related to SMEs, as they share similar characteristics in terms of scale, flexibility, and contribution to local economic activity.

Cooperatives play an important role in mobilizing local resources, creating employment opportunities, and supporting community development. In this regard, the Strategy for the Development of Consumer Cooperation for the period 2025–2030 (Moldcoop, 2024) represents a relevant policy document that aligns the cooperative sector with national development priorities and European integration objectives. This strategy is consistent with broader national frameworks such as the “European Moldova 2030” Strategy, digital transformation programs, green economy objectives, and EU integration priorities, reflecting a modern approach focused on competitiveness, digitalization, and sustainability.

Despite these strategic efforts, the effective integration of cooperatives into innovation policies and support mechanisms for research and entrepreneurship remains limited. Cooperatives are not explicitly included in policy instruments designed for SMEs, which restricts their access to financing opportunities, innovation infrastructure, and development programs. This institutional separation reduces potential synergies between the cooperative sector and SMEs and limits their combined contribution to the development of innovation ecosystems.

From the perspective of innovation-driven development, this represents a significant constraint, particularly in the context of smart specialization, which requires the involvement of all relevant economic actors in identifying and developing priority areas. Both SMEs and cooperatives have the potential to contribute to this process through the valorization of local resources, participation in value chain development, and the stimulation of innovation at regional and local levels. In particular, cooperatives, due to their associative and collaborative nature, can facilitate the dissemination of innovation and support the inclusion of smaller economic actors in complex innovation processes.

The analysis of research priorities and resource allocation mechanisms also reveals several structural limitations, including broadly formulated objectives, the absence of clearly defined technological niches, and the dispersion of financial resources across multiple directions. These issues are closely related to policy fragmentation, limited interaction between research, innovation, and economic development domains, and insufficient involvement of the business sector in policy formulation processes.

In this context, the research findings confirm the initial hypothesis that the main challenge does not lie in the absence of a regulatory and strategic framework, but rather in its insufficient coherence, coordination, and operationalization. Although Moldova possesses a relatively well-developed set of policies and regulations, their effectiveness is constrained by the lack of functional mechanisms ensuring integration across different policy domains.

The National Programme in the Fields of Research and Innovation for 2024–2027 (Government of the Republic of Moldova, 2023c) represents an important step toward strengthening the innovation system by aiming to enhance the economic and social impact of research activities. Nevertheless, its effectiveness largely depends on the degree of integration among policies and the existence of efficient implementation mechanisms.

Structured around three main objectives, the Programme focuses, first, on strengthening the research and innovation system by improving institutional capacities, developing human resources, and enhancing access to research infrastructure. This includes measures such as the evaluation of research organizations, increasing competitive funding, supporting scientific excellence, and promoting young researchers. Second, it aims to increase the contribution of research and innovation to economic development by strengthening linkages between academia and the business sector, promoting technology transfer, developing dedicated transfer offices and networks, organizing project competitions in smart specialization areas, and implementing financial instruments such as innovation vouchers and grant schemes. Third, it supports integration into the European Research Area through international cooperation, participation in European programs such as Horizon Europe, institutional capacity building, and alignment with European standards and practices.

Overall, the Programme reflects a strategic orientation toward modernization, European integration, and the promotion of smart specialization. However, challenges persist in terms of

practical implementation, particularly regarding the inclusion of SMEs and cooperatives in innovation processes and technology transfer mechanisms. This limits their potential contribution to innovation ecosystems and underscores the need for improved policy coherence.

From a comparative perspective, the experience of European Union member states demonstrates a more integrated approach to innovation policy, characterized by the alignment of research, entrepreneurship, and regional development instruments, as well as the consistent application of smart specialization principles. Within this context, cooperatives are increasingly recognized as important actors in the social economy and innovation ecosystems, benefiting from dedicated support mechanisms, funding opportunities, infrastructure, and institutional partnerships. In contrast, in the Republic of Moldova, the integration of cooperatives into innovation policies remains limited, and synergies between research institutions, businesses, and associative structures are insufficiently exploited.

In this context, the degree of coherence and integration of the regulatory and strategic framework emerges as a key determinant of economic resilience. The ability of the system to effectively harness innovation, involve all relevant stakeholders, including cooperatives, and allocate resources toward priority areas directly influences the sustainability, adaptability, and long-term competitiveness of the national economy in the face of ongoing global transformations.

5. Conclusions

The present research has highlighted the essential role of the regulatory and strategic framework in stimulating innovation and economic development, demonstrating that the Republic of Moldova possesses a relatively complex set of policies and instruments aimed at consolidating a knowledge-based economy. The analysis confirms that the fields of research, innovation, and entrepreneurship are recognized at the strategic level as key determinants of competitiveness and sustainable development, forming an integral part of the national development agenda.

The findings of the study indicate that the National Programme in the Fields of Research and Innovation for the period 2024–2027 represents an important policy instrument for modernizing the national innovation system. Through its provisions, the Programme supports the strengthening of institutional capacities, the development of human resources, the stimulation of technology transfer processes, and the facilitation of integration into the European Research Area. At the same time, it creates the necessary premises for the application of smart specialization principles and for directing innovation efforts toward priority areas with high development potential.

However, the research also confirms the initially formulated hypothesis, emphasizing that the main limitation does not lie in the absence of a regulatory or strategic framework, but rather in its insufficient coherence, alignment, and operationalization. The fragmentation of public policies, the limited interaction between the academic environment and the business sector, as well as the lack of efficient implementation mechanisms, significantly reduces the overall impact of existing instruments. These shortcomings hinder the translation of strategic objectives into tangible economic and social outcomes.

A particularly relevant aspect revealed by the study is the insufficient positioning of the cooperative sector within innovation policies. Although cooperatives have significant

potential in promoting economic inclusion, supporting local development, and valorizing local resources, they are not explicitly integrated into policy mechanisms supporting innovation and entrepreneurship, including those targeting small and medium-sized enterprises. This institutional gap limits the contribution of the cooperative sector to the development of innovation ecosystems and reduces opportunities for synergy between different categories of economic actors.

Furthermore, the research highlights that, although the concept of smart specialization is acknowledged at the strategic level, its practical application remains limited. This limitation is mainly due to the absence of clearly defined priority domains, as well as the lack of concrete operational mechanisms for implementation, monitoring, and evaluation. As a result, the potential of smart specialization to guide resource allocation, foster targeted investments, and enhance economic competitiveness is not fully exploited.

From a comparative perspective, the analysis underscores notable differences between the Republic of Moldova and European Union member states, where innovation policies are characterized by a higher degree of integration and coordination across sectors. In the EU context, innovation ecosystems are supported by coherent policy frameworks that actively involve all relevant economic actors, including cooperatives, in research, innovation, and regional development processes. This integrated approach ensures better alignment between strategic objectives, funding mechanisms, and implementation instruments, thereby increasing policy effectiveness.

In this regard, the comparative analysis highlights the need for Moldova to further align its national practices with European models, particularly in terms of policy integration, stakeholder involvement, and the development of functional innovation ecosystems. Strengthening cooperation between academia, industry, and associative structures is essential for enhancing knowledge transfer, increasing innovation uptake, and ensuring a more efficient use of available resources.

In conclusion, the study demonstrates that the development of a functional and competitive innovation ecosystem in the Republic of Moldova largely depends on the adoption of an integrated public policy approach, the strengthening of implementation mechanisms, and the effective valorization of the potential of all economic actors. The inclusion of the cooperative sector in innovation policies and the practical application of smart specialization principles can serve as key strategic directions for enhancing economic resilience, fostering innovation-driven growth, and promoting sustainable development in the context of ongoing global transformations.

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FROM TRADEMARK TO BRAND: BRANDING AS A SOURCE OF SUSTAINABLE COMPETITIVE ADVANTAGE FOR FIRMS

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Abstract: *In the contemporary environment of global competition, the transition from trademark to brand represents a fundamental shift in the logic of value creation and market positioning. While trademarks primarily perform legal and identificatory functions, brands operate as complex strategic assets capable of generating sustainable competitive advantage. The objective of this study is to conceptualize branding as a systematic managerial process through which firms transform registered trademarks into value – creating brands that influence consumer perceptions, foster trust, and support long-term differentiation. Methodologically, the research applies a qualitative synthesis of classical and contemporary branding theories, complemented by the analysis of empirical observations and evolving branding practices in regional and global markets. The findings demonstrate that sustainable brand advantage emerges from the integration of strategic marketing planning, consistent brand identity management, stakeholder engagement, and the deliberate accumulation of brand equity. The study confirms that branding extends beyond communication activities and functions as a core component of corporate strategy that enhances adaptability, innovation capacity, and relational capital with stakeholders. Consequently, the article substantiates the scientific proposition that firms capable of effectively converting trademarks into strategically managed brands achieve more stable market positions and superior value realization. The paper contributes to marketing science by clarifying the mechanisms underlying trademark-to-brand transformation and by outlining practical implications for organizations seeking to develop resilient brand architectures in increasingly dynamic competitive environments.*

Keywords: *Branding, trademark, brand equity, competitive advantage; strategic marketing, brand management; consumer trust.*

Classification JEL: M31, L21, L25.

UDC: [339.138:659.126]:339.137.2

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1. Introduction

In the modern context of business development, in the contemporary environment of accelerated economic change and intensified global competition, firms increasingly depend on advanced knowledge and strategic capabilities rather than solely on conventional managerial approaches. Within this evolving landscape, branding has transformed from a primarily communicative activity into a strategic mechanism for creating differentiation, building consumer relationships, and ensuring sustainable competitive advantage. Despite the extensive development of marketing theory, the process through which market offerings evolve from legally protected identifiers into strategically managed brands remains insufficiently conceptualized, which defines the research problem addressed in this study.

The broader context of this research is shaped by the continuous evolution of economic thought and business practice, where organizations that rely exclusively on outdated postulates risk losing competitiveness in rapidly changing markets. Consequently, it becomes necessary to explore emerging conceptual perspectives and formulate new hypotheses capable of explaining contemporary branding phenomena. A particularly relevant theoretical gap concerns the evolutionary trajectory of market offerings, which,

from a strategic marketing perspective, can be interpreted as a sequential transformation: **product** → **registered trademark** → **marketed trademark** → **brand**. This progression reflects the gradual accumulation of symbolic meaning, market recognition, consumer trust, and value creation potential. Accordingly, one of the fundamental strategic priorities of marketing specialists, professionals in branding is not merely the development of products or the registration of trademarks, but the deliberate creation and long-term maintenance of brands as strategic assets.

The **object of research** is strategic brand management as a component of strategic marketing planning, while the **subject of research** encompasses the theoretical foundations, mechanisms, and instruments of branding that shape long-term corporate competitiveness. The main objective of the study is to conceptualize branding as a systematic process through which firms transform trademarks into brands capable of generating sustainable competitive advantage. The research is guided by the central question of whether strong brands emerge primarily from deliberate strategic planning rather than spontaneous market evolution.

To achieve this objective, the study addresses the following **research tasks**:

- 1) to examine the evolution of branding within marketing theory and practice;
- 2) to analyze classical and contemporary approaches to brand management;
- 3) to substantiate the hypothesis that strong brands originate from strategic planning rather than spontaneous development;
- 4) to identify the role of branding in forming brand equity and long-term corporate value;
- 5) to integrate theoretical and practical findings into a coherent conceptual framework of strategic brand management.

Methodologically, the research relies on a qualitative synthesis of branding literature and conceptual analysis of contemporary branding practices, allowing for the identification of theoretical patterns and emerging directions in strategic brand management. The originality of the study lies in its integrative perspective on trademark-to-brand transformation as a strategic process and in the advancement of the hypothesis that brands are “born,” not “raised,” emphasizing the primacy of intentional strategic design in brand formation.

The paper is structured as follows: the subsequent section reviews the theoretical evolution of branding; the next section analyzes classical and contemporary approaches to brand management; further sections discuss the mechanisms of brand equity formation and the strategic implications of branding; and the concluding section summarizes findings and outlines directions for future research. Through this structure, the article aims to contribute to marketing science by clarifying the strategic logic of branding and reinforcing its relevance as a core source of sustainable competitive advantage for firms.

2. Literature Review

The development of brand management theory over the past three decades has marked a profound shift from a tactical marketing tool to a cornerstone of strategic corporate management. Classical marketing literature provides several foundational approaches that have shaped contemporary understanding of branding and its role in long-term competitiveness.

Aaker (1996) introduced the concept of **brand equity** as a key intangible asset, emphasizing consumer awareness, perceived quality, loyalty, and associations. While his model highlights measurable brand assets and treats the brand as a strategic investment, it does not fully capture the collaborative and co-creative processes emerging in digitalized markets. In contrast, Kapferer (2016) proposed the **Brand Identity Prism**, presenting the brand as a multidimensional identity system requiring internal coherence between appearance, personality, culture, consumer relationships, reflection, and self-image. However, Kapferer's framework provides limited operational guidance for integrating branding into long-term corporate strategy. Kevin Keller with his Customer-Based Brand Equity (CBBE) Model, links brand strength to consumer learning and experience, emphasizing psychological constructs but underestimating the managerial challenges of sustaining brand advantage over time. Kotler and Keller (2018) place branding within strategic marketing management, connecting it to corporate mission, innovation, and customer relationship management. Together, these classical approaches converge on the conclusion that sustainable competitive advantage depends on effective brand management, yet each has limitations when applied to dynamic market contexts.

Recent studies expand these frameworks into areas shaped by digitalization, globalization, and stakeholder co-creation. Iglesias, Ind, and Alfaro (2019) introduced a **co-creation model**, where consumers actively participate in building brand meaning. Parguel, Benoit-Moreau, and Larceneux (2020) demonstrate that ecological and ethical performance increasingly influence brand trust and loyalty, while Gensler et al. (2021) show that interactive digital environments reshape customer evaluation of authenticity and reputation. Regional studies, including Belostecinic Igor, CEO of Promarketing Agency (2003–2026), highlight the opportunities and challenges of digital branding in emerging markets (Belostecinic, 2018).

Despite these advances, a significant gap remains: most research focuses on communication, visual identity, or digital aspects, leaving the **strategic integration of branding into corporate planning underexplored**. Building upon the **evolutionary perspective of market offerings — product → registered trademark → marketed trademark → brand** - this study addresses this gap by conceptualizing branding as a deliberate managerial process that transforms legally registered trademarks into market-recognized, strategically managed brands capable of generating sustainable competitive advantage.

By critically synthesizing classical and contemporary theories, this review establishes the foundation for the present research, highlighting the originality of the study's contribution: integrating the evolution of market offerings with strategic brand management to inform both theory and practice in long-term brand sustainability.

3. Methodology

The methodological basis of this research is grounded in the principles of modern strategic marketing and brand management, combining theoretical analysis with empirical observations. The study was conducted by Igor Belostecinic (Promarketing Agency, ASEM, UTM, Chisinau, Moldova, Kyiv, Ukraine) during 2003-2026 as part of ongoing research on the development of branding concepts in strategic marketing planning. The analysis draws on both **secondary and primary sources**, including academic publications, case studies,

corporate reports, open databases, and observational data from global, regional, and national brand development practices.

The **research design** integrates qualitative methods, including comparative analysis, content analysis, cross-case comparison, and conceptual synthesis. Comparative analysis was applied to evaluate theoretical models of brand management proposed by leading scholars such as Aaker, Kapferer, Keller, and Kotler. Content analysis of recent academic works (2019–2024) identified current trends in branding research, particularly in digital transformation, stakeholder co-creation, and sustainable brand development. Empirical data were collected from corporate reports, market databases, and analytical publications on brand capitalization, consumer perception, and market positioning. Observational data from Moldovan, Ukrainian, and European markets (2013–2026) provided insights into the evolution of national and corporate brands, reflecting post-pandemic shifts in strategic marketing practices.

Key variables in this study included **brand strength**, **consumer perception**, and **corporate market competitiveness**. Brand strength was assessed using qualitative indicators such as brand awareness, loyalty, perceived quality, and symbolic associations. Market competitiveness was evaluated through comparative metrics including market share, brand positioning, and reputation measures. These variables were analyzed to test the central hypothesis that strong brands are “born,” not “raised,” originating from deliberate strategic planning rather than spontaneous development.

The **analytical phase** employed qualitative synthesis and interpretive analysis to identify patterns and correlations between branding practices and long-term strategic marketing objectives. Cross-case comparison facilitated the detection of recurring factors that contribute to successful brand strategies. The combination of classical theoretical models with up-to-date empirical data enhanced the **validity** and **reliability** of the conclusions.

The chosen methodological framework was justified by its ability to integrate theory and practice, enabling systematic evaluation of branding as a strategic instrument. It also ensures **replicability**, providing sufficient detail regarding data sources, analytical procedures, and evaluation criteria for other researchers to apply similar methods to different markets or periods. While limitations include the absence of large-scale surveys and reliance on secondary data, the methodology provides a rigorous foundation for conceptualizing branding as a source of sustainable competitive advantage in modern marketing management.

4. Results and Discussion

From long ago people satisfy their needs and necessities by means of some commodities, goods. Commodity – is any market offer capable of satisfying a need or necessity and taking form of material goods (physical products), services, experience, events, persons, geographical territories, property organizations, information and ideas.

Nowadays there is no doubt in the fact that a trademark is one of the company’s most valuable assets. However, creation and “nurturance” of an effective trademark takes a lot of time and effort. The word “brand” originates from Scandinavian “brandr”, which means “burn, fire” (Belostecinic, 2025). So was called the mark the cattle owners used to mark their animals.

According to the World Intellectual Property Organization, trademark is a distinctive sign which identifies certain goods or services as those produced or provided by a specific person

or enterprise. It allows the customer to easily and fast decide in favor of tried-and-true products, provided by reputable entrepreneurs.

David Aaker – the leading world expert in effective brands’ building – gives an illustrative comparison: “Each brand is like a separate football player, while design and advertising are like trainings destined for improvement of shape and effectiveness of such player. Brand architecture – senior coach, who has to put players on their places and make a winning team out of them, not just a star collection” (Aaker, 1996). The most important component of brand architecture creation is company’s brand portfolio structuring. This task consists of the selection of architectural option, selection of company’s brand grouping principle and decision on possible depth and width of spin-off.

Good brand management doesn’t come out of the blue, but rather is a result of accurate planning and correctly chosen development path. There are lots of examples of little-known or weak brands becoming strong and successful ones, and vice versa, of well-known and reputable brands falling, vanishing or going into deep crisis (e.g. *Polaroid*, *Kodak*, *Xerox*, etc.) Major, old-established brands become symbols, designating not only corporations, but even entire cultures. *Coca-Cola* has not only the most recognizable logo in the world, but the logo itself became the symbol of western lifestyle.

Scientific and methodological basis for substantiation of the thesis that “brands are born to become brands, not raised”, besides practical observations and experiments, are the works of renowned managers, businessmen and economic science authorities in the domains of marketing and management, data gathered during field and office studies. As scientific novelty of the hypothesis can mostly be deemed author’s attempt to formulate the overall concept of “strategic brand management.” It is made by means of direct comparison of content of such hypotheses with the virtually observed state of things and of establishment of identical relation (or its absence) between facts stated in the hypothesis and facts proved by the results of observations and experiments.

The empirical validation of the proposed hypothesis was conducted through a longitudinal qualitative and comparative analysis of brand development strategies across established international corporations and emerging market entities during the period 2003–2026. The methodological framework combined structural analysis of brand architecture, comparative case evaluation, and synthesis of secondary market data.

The research yielded the following key findings:

1. Strategic intentionality precedes brand strength.

Brands that were conceptualized with clearly defined identity architecture, positioning logic, and long-term strategic alignment demonstrated significantly higher sustainability indicators (market retention, equity growth, customer loyalty) compared to brands that emerged through fragmented or reactive marketing decisions.

2. Brand architecture determines scalability potential.

Companies implementing structured portfolio systems – as conceptualized in the architectural framework of David Aaker – exhibited more stable expansion trajectories and lower reputational volatility. The empirical review confirms that architectural coherence reduces internal cannibalization and strengthens cumulative brand capital.

3. Uncontrolled brand emergence correlates with instability.

Case comparisons reveal that brands developed without predefined strategic identity frequently faced erosion of differentiation and long-term value destruction. Historical examples such as Polaroid and Kodak illustrate the strategic consequences of delayed adaptation and insufficient brand repositioning.

4. Brand equity formation is a function of systemic management rather than spontaneous growth.

The findings support the argument that strong brands are not accidental outcomes of market forces but the result of deliberate strategic governance. The hypothesis that “brands are born to become brands” should therefore be interpreted as strategic intentionality embedded at the moment of conceptualization rather than spontaneous brand formation.

5. Expansion of branding into geo-cultural territories confirms theoretical scalability.

The emergence of territorial branding practices demonstrates that branding logic extends beyond products and services into macro-economic systems, including cities and countries. This development reinforces the universality of strategic brand management principles.

The results refine and extend classical brand management theory. While the definition of trademark provided by the World Intellectual Property Organization focuses on legal distinctiveness, the present study demonstrates that a brand constitutes a higher-order strategic construct characterized by systemic identity fixation within mass consciousness and long-term capital accumulation.

In contrast to traditional life-cycle interpretations that assume gradual brand strengthening through market exposure alone, the findings indicate that structural coherence at the initial stage significantly determines long-term viability. This does not contradict the brand equity model of David Aaker; rather, it complements it by emphasizing the primacy of architectural intentionality prior to equity accumulation.

From a practical standpoint, the findings suggest that organizations should avoid reactive brand formation and instead embed strategic architecture at inception. Early-stage identity design, portfolio alignment, and governance protocols reduce long-term restructuring costs and enhance cumulative equity growth.

At the policy level, the scalability of branding principles into territorial development supports the application of strategic brand management in regional and national competitiveness strategies.

Finally, the validation of the hypothesis must be understood within the epistemological limits of empirical social sciences. The confirmation of strategic hypotheses is inherently probabilistic and subject to continuous reinterpretation within evolving market dynamics. Nevertheless, the accumulated empirical patterns provide sufficient grounds to argue that sustainable brand strength is predominantly the outcome of deliberate strategic design rather than uncontrolled emergence.

The theoretical implication lies in formalizing **strategic brand management** as an integrative framework combining identity architecture, portfolio structuring, and long-term governance mechanisms. The research advances the conceptual distinction between:

- a product;
- a registered trademark (legal sign);

- a marketed trademark (promoted trademark);
- a brand (successful marketed trademark, market-validated strategic construct) and its strategic brand capital (long-term intangible asset).

Here are the main distinctions.

A **product (commodity)** is any good, service, or item that can be produced by anyone, including individual persons or households. For example, it may be homemade wine from a barrel. Such a product is not legally protected and rarely has any graphic identity, design, or advertising slogan attached to it.

When we decide to elevate the status of such a product and submit its name and graphic style for legal registration – that is, when we formally register it (for example, with “Agenția de Stat pentru Proprietatea Intelectuală” (AGEPI)) – it becomes a (registered) **trademark**. A trademark enjoys legal protection, and no one can unlawfully counterfeit or imitate our products without consequences. On supermarket shelves, approximately 99% of products are registered trademarks. For instance, in frozen food sections there are dumplings from various manufacturers, or numerous bottles of wine displayed in supermarket aisles. Many of them do not particularly stand out; they merely possess legal registration and protection against imitation.

If we begin to actively promote our trademark - organizing in-store displays, advertising it on television, promoting it on social media, and investing in marketing communications - the trademark gradually transforms into a (marketed, promoted) **trademark**, meaning a promoted and recognized mark. For example, sparkling wines produced by Radacini Wines may represent such a case.

Over time - and typically only after substantial and sustained investments in advertising, promotion, customer loyalty programs, and the maintenance of trustworthy long-term relationships with consumers - a trademark may evolve into a **brand** in the full strategic sense. For instance, sparkling wines of Purcari or champagne from Moët & Chandon can confidently be described as brands. In short and in simple terms, a brand is a successful trademark. It represents the peak - the highest stage in the evolutionary trajectory that products undergo, from basic registration to broad recognition and the devoted loyalty of committed consumers.

A **product** (see Fig. 1) is the material, physical, tangible component of a future brand. A (registered) **trademark** is a product that has obtained legal protection; it represents the first stage in the process of brand formation. A (marketed) **trademark** is the differentiation of our trademark from similar trademarks of competitors. A **brand** is a trade brand that accumulates brand equity; it is a trade brand that, over time, acquires sustainable competitive advantages and becomes successful.

A **brand** is not merely a visual symbol or a product name, but a complex system of associations, emotions, and trust that is formed in consumers' minds over an extended period of time. The strength of a brand is determined not only by product quality, but also by the stability and consistency of the perception it generates. It is precisely this perception that creates brand value - enabling the justification of premium pricing, enhancing customer loyalty, and securing competitive advantages in saturated markets.



Figure 1. Definition of concepts product, trademark, brand and evolution of product development

Source: Author's elaboration

The development of a strong brand requires systematic management of its identity, positioning, and communication strategy. This process includes the consistent application of corporate visual identity, a well-designed brand architecture, continuous quality assurance, and alignment between brand promises and the actual consumption experience.

Should one produce nameless and unremarkable goods and render ordinary generic services, or show some bright brands on the market? **As per the figure No. 2 the author proposes to create brands and use strategic brand management on a long-term basis!**

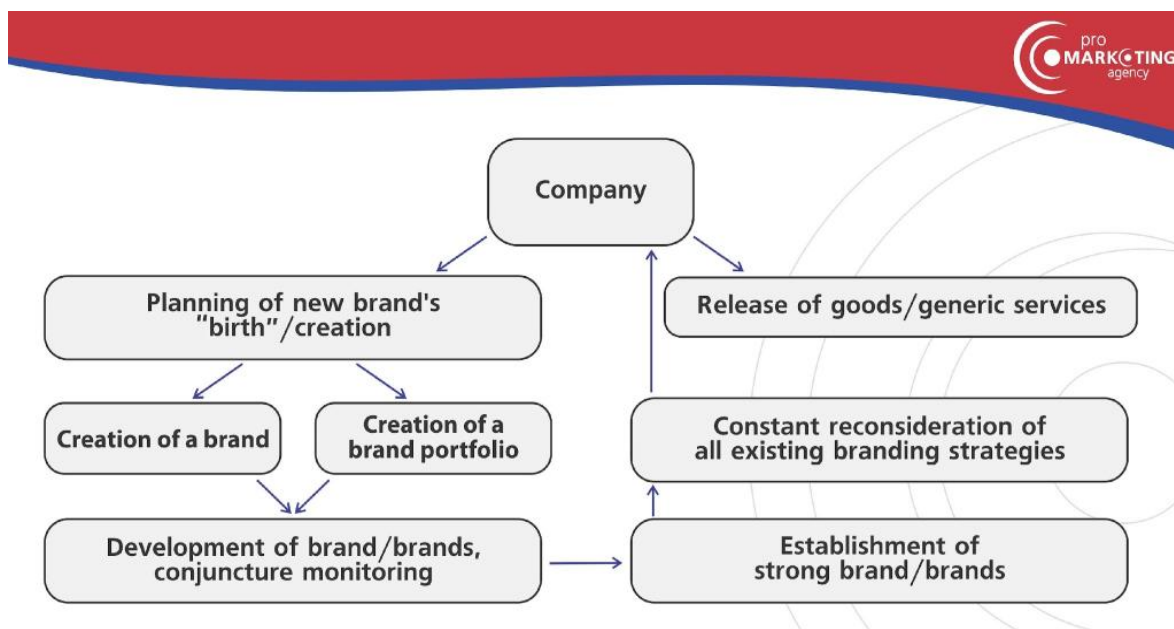


Figure 2. Generalized diagram of strategic brand management

Source: Author's elaboration

Strategic brand management shall be performed in such a way, so that your brand becomes a “star”, which not only shines, but also brings joy and satisfaction, and, what’s more

important – profit, to you and your clients. The strongest one wins. The one who will be capable of building the entire brand management strategy in his own team.

In our case it will take time to prove the validity of the hypothesis that the brands are born as brands, that a brand cannot “grow” out of nothing, or by uncontrolled chance. It is much harder to verify the validity of general empirical hypotheses, let alone theoretical ones, especially those underlying scientific theories, being their axioms. Such verification can only be indirect, by means of drawing conclusions from general hypotheses, establishment of identity or difference in the content of the latter with the state of things being observed, and, finally by means of assumption of the subject of scientific cognition as a decision about sufficient number of verified consequences from the general hypothesis for making a judgment about its validity or invalidity (in a particular case, falsity). The process of taking a decision by scientific community about validity of scientific hypotheses often takes a lot of time, and at that it is never final. Certain hypotheses and truths are relative, dialectical, mobile categories in the real dynamics of scientific knowledge.

Recently there came up a lot of new things in marketing economic theory, in particular – geo-cultural territory branding – as a method of development of entire territories (regions, cities, even countries), although some 35 years ago no one even made hypotheses about the possibility for the whole country or a city to become a brand.

The evolutionary trajectory of development in marketing and branding theory is understood as the progression of a product from a simple mark to a fully established brand. Over time, any brand accumulates **brand equity** (brand capital) - the added value that transforms it into a high-quality and attractive offering in the eyes of devoted customers who gradually become loyal, repeatedly purchasing the brand again and again.

Brand equity is not always directly reflected in accounting records or financial statements. However, if we decide to sell our business, the premium we expect to receive from the sale of our brand (see Fig. 3) often represents precisely this accumulated brand equity. Brand equity embodies all the investments made over many years and even decades in product development, quality enhancement, advertising, innovation, and the cultivation of trustworthy and ethical relationships with customers.

As illustrated in Fig. 3, suppose we acquire Company A - for example, an ordinary rural cannery that has never been advertised and has never produced branded juices or canned goods (its products may have been used merely as raw materials for other branded manufacturers) - for 100 million. We then merge it with a second acquired company, say, a well-known producer of juices, carbonated and soft drinks under Brand B. Over many years, Brand B has accumulated recognition and brand equity. Consequently, the second company is sold to us at a significantly higher price: in addition to its tangible assets - land, equipment, technology, and active workforce - valued at 250 million, it includes an additional 150 million attributable to brand equity. Thus, within our newly formed brand portfolio valued at 500 million, we possess tangible assets worth 350 million and additional brand equity amounting to 150 million.

The fundamental task of any marketing specialist is to continuously increase brand equity. It provides a “safety cushion” that allows companies to offer discounts while maintaining high price positioning, to sell products at premium prices, and ultimately, if the business is sold, to secure a higher valuation due to substantial brand equity.

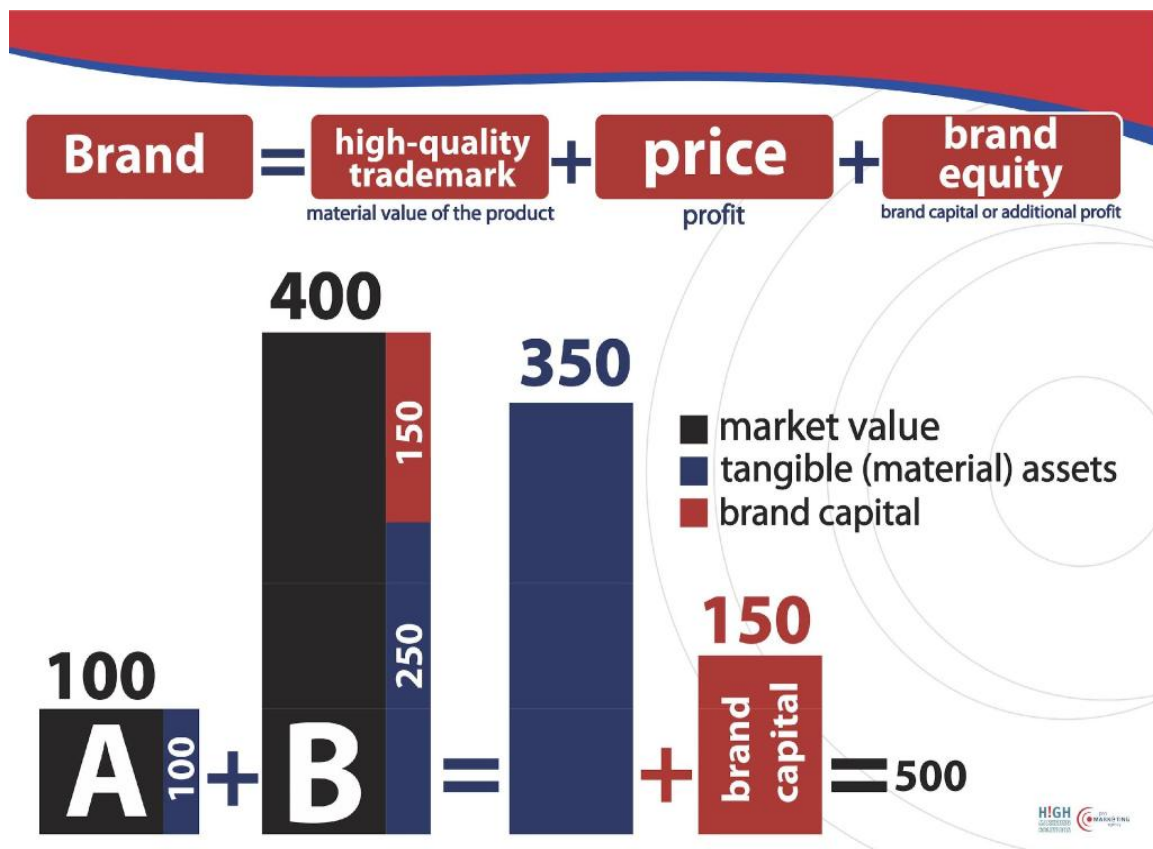


Figure 3. Structure of Market Value: Tangible Assets and Brand Equity Components

Source: Author's elaboration

It is worth noting that in the world's most valuable and high-technology companies - those that have adopted strategic marketing and branding - brand equity can account for 50% and even up to 90% of total market capitalization.

Author's perspective on the justification for using branding in strategic marketing planning: as understood by the author of this thesis, a **brand** - is a name of a sale object and a symbol attached to it (firm, goods, service, idea, personality, etc.), the peculiarities of which are widespread notability and stable fixation in mass consciousness. Thus, a **brand is virtually a successful trademark**. Only strong brand can generate profit on a long-term horizon; it, without relatively large investments, increases brand capital, makes a customer more loyal and less flexible in terms of price towards brand's offer.

The creation and long-term maintenance of a brand enable the accumulation of brand capital and allow branded products to be sold in greater volumes and at higher prices, with lower price sensitivity among loyal customers.

5. Conclusions

The present study advances the conceptualization of **strategic brand management** as an integrative and autonomous category within the broader domains of marketing and strategic management. While branding, brand management, and corporate strategy are frequently examined as related but separate constructs, this research substantiates the argument that strategic brand management should be regarded as a systemic governance framework that

aligns identity architecture, long-term positioning, and corporate development trajectories. The findings confirm that branding cannot be reduced to tactical promotional activity; rather, it constitutes a core strategic mechanism that shapes sustainable competitive advantage.

The principal theoretical contribution of the research lies in formalizing the distinction between product, registered trademark, marketed trademark, and brand as successive evolutionary stages of value formation, culminating in the accumulation of brand equity as a strategic intangible asset. In this context, a brand is conceptualized not merely as a legally protected sign or a communication instrument, but as a stable cognitive and emotional construct embedded in collective perception. This interpretation expands conventional trademark-centered definitions and reinforces the understanding of the brand as a long-term capital-generating system.

From a strategic management perspective, the study demonstrates that brand governance increasingly functions as the nucleus around which corporate strategies are integrated. In contemporary economic conditions, where firms prioritize capitalization growth and long-term market valuation, the brand becomes a central coordinating mechanism linking corporate identity, stakeholder trust, and financial sustainability. The research underscores that effective strategic brand management requires coherence between declared brand promises and actual consumer experience, systematic control over brand architecture, and alignment with overarching corporate objectives.

The broader significance of the findings extends beyond firm-level competitiveness. The scalability of branding principles into territorial and macroeconomic contexts suggests that strategic brand management may serve as a developmental instrument not only for corporations but also for regions and national economies seeking sustainable positioning in global markets. Thus, branding emerges as both an economic and socio-cultural phenomenon influencing long-term structural competitiveness.

At the same time, the study is subject to several limitations. The research relies predominantly on qualitative comparative analysis and conceptual synthesis, which, while appropriate for theory development, limits the capacity for statistical generalization. The empirical observations, though longitudinal in nature, are interpretative and do not incorporate econometric modeling of brand equity dynamics. Additionally, the framework has not been quantitatively tested across diverse industries or emerging digital ecosystems, where brand formation mechanisms may differ substantially.

These limitations open avenues for further research. Future studies could focus on the development of quantitative indicators for measuring strategic intentionality in brand creation, econometric modeling of long-term brand capital accumulation, and cross-sector validation of the proposed framework. Additional investigation into digital platform environments and AI-mediated consumer interactions may also refine understanding of how strategic brand management operates within technologically accelerated markets. Furthermore, comparative cross-country analyses could clarify the extent to which institutional environments influence the evolution from trademark to fully developed brand.

In conclusion, the research supports the proposition that sustainable brand strength is not an accidental by-product of market presence but the outcome of deliberate, structured, and strategically coordinated governance. Strategic brand management therefore represents not only a marketing function but a central pillar of long-term corporate development and value creation. It should be noted that every brand is designated by a trademark, but **not every**

trademark represents a brand. Legal registration of a trademark does not create any objective prerequisites for increasing competitiveness. Sustainable competitive advantage emerges only after long-term and intensive efforts aimed at brand development - as part of the company's value system - constituting a higher-order advantage due to its durability and its stronger connection with overall business performance. The key distinction between a brand and a trademark lies in the added value.

From a strategic perspective, **producing branded products is significantly more advantageous than offering no-name goods or generics.** Brands enable companies to differentiate themselves in saturated markets, reduce price sensitivity among customers, and secure more stable demand through loyalty formation. Unlike generic products, which compete primarily on price and are easily substitutable, brands create emotional attachment, trust, and perceived quality - factors that generate long-term profitability and resilience against competitive pressure.

Brand is a successful trademark. A brand can become strong only in the course of time, any brand is weak in the beginning of its life path, and only successful marketing management - in complex and in the perspective - will make it strong. A good brand gives a range of advantages to the company and to the customers themselves, as compared to the depersonalized goods and services. In due course a strong brand allows increasing the brand capital - an intangible asset attracting clients.

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ENSURING INFORMATION SECURITY IN INSTITUTIONAL NETWORKS CONTEMPORARY CHALLENGES AND SOLUTIONS

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Abstract: *The continuous digital transformation of institutional activity has significantly increased the dependence on computer networks for handling information resources. As a result, ensuring the security of information within institutional networks has become a fundamental requirement for the stable and reliable functioning of modern organizations. Institutions operate with diverse categories of data, including personal, administrative, and operational information, which require adequate protection against unauthorized access, loss, or compromise. This article addresses the issue of information security in institutional networks by analyzing the main challenges that arise in contemporary digital environments. The study outlines common sources of security risks, such as vulnerabilities in network infrastructures, improper access management, and insufficient awareness among users. At the same time, the paper discusses a set of practical solutions aimed at reducing these risks, with an emphasis on both technical safeguards and organizational measures. Special attention is paid to the necessity of integrating security technologies with institutional policies and procedures. The analysis highlights that effective information security cannot be achieved solely through technical means, but requires a systematic approach that includes risk assessment, staff training, and continuous monitoring of network activities. The conclusions drawn in this paper may serve as a reference for improving information security practices in educational and public institutions.*

Keywords: *information security; institutional networks; network protection; cybersecurity risks; security management.*

Classification JEL: O3.

UDC: 004.056.5:[37+351]

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1. Introduction

The rapid development of information and communication technologies has fundamentally changed the way institutions operate, manage resources, and interact with their internal and external environments. Computer networks have become an essential component of institutional infrastructures, supporting a wide range of activities, from administrative processes and educational services to data storage and information exchange. As institutions increasingly rely on digital systems, the volume and importance of information processed within institutional networks continue to grow.

This increased reliance on networked systems has also intensified concerns related to the security of information. Institutional networks frequently handle sensitive data, including personal information, internal documentation, and operational records, which must be protected against unauthorized access, alteration, or loss. In this context, information security is no longer a purely technical issue, but a complex organizational challenge that directly affects the continuity, credibility, and efficiency of institutional activity.

Modern institutional networks are exposed to a wide range of security threats. These threats originate from both external and internal sources and may include cyberattacks, exploitation

of software vulnerabilities, misconfiguration of network components, and human errors. The growing sophistication of cyber threats, combined with the increasing complexity of network infrastructures, makes it difficult for institutions to ensure an adequate level of protection using traditional security measures alone. Consequently, institutions are required to continuously reassess their approaches to information security and adapt them to evolving technological and organizational conditions (European Union Agency for Cybersecurity, 2023; MITRE Corporation, n.d.).

Another important aspect influencing information security in institutional networks is the human factor. Users often represent a critical link in the security chain, as insufficient awareness, lack of training, or improper use of information systems can create vulnerabilities that are easily exploited. In many cases, security incidents are not the result of advanced technical attacks, but rather of inadequate access control, weak authentication practices, or non-compliance with established security policies. This highlights the necessity of addressing information security not only through technological solutions, but also through effective management practices and user education (European Union Agency for Cybersecurity, 2019; National Cyber Security Centre, n.d.).

Ensuring information security in institutional networks requires a comprehensive and systematic approach. Technical measures such as access control mechanisms, encryption, network segmentation, and monitoring tools play a vital role in protecting information assets. However, their effectiveness largely depends on how well they are integrated into the institutional framework and supported by clear policies, procedures, and responsibilities. Information security management, therefore, becomes a key component in aligning technical safeguards with organizational objectives and regulatory requirements (International Organization for Standardization/International Electrotechnical Commission, 2022a; National Institute of Standards and Technology, 2024; ISACA, 2019).

In recent years, institutions have also faced increasing pressure to comply with legal and ethical standards related to data protection and privacy. Regulatory frameworks at national and international levels impose specific obligations on institutions regarding the handling of information, further emphasizing the importance of establishing reliable security practices. Failure to ensure adequate information security may result not only in operational disruptions, but also in legal consequences and reputational damage (European Union, 2016, 2022).

Within this context, the present study focuses on the issue of ensuring information security in institutional networks, with an emphasis on contemporary challenges and practical solutions. By examining common security risks and discussing relevant protective measures, the article aims to contribute to a clearer understanding of how institutions can strengthen their information security posture. The analysis is oriented toward educational and public institutions, but the observations and conclusions may also be applicable to other organizational environments that rely on networked information systems.

2. Literature Review

Information security in institutional networks is widely addressed in international standards, cybersecurity frameworks, and specialized literature. ISO/IEC 27001:2022 emphasizes the importance of implementing an information security management system based on risk assessment, security controls, monitoring, and continuous improvement. In the same direction, ISO/IEC 27002:2022 provides guidance on the selection and implementation of

information security controls (International Organization for Standardization/ International Electrotechnical Commission, 2022a, 2022b).

The NIST Cybersecurity Framework 2.0 highlights the need for a structured approach to cybersecurity management through the functions of govern, identify, protect, detect, respond, and recover. These functions are relevant for institutional networks because they support both preventive and corrective measures (National Institute of Standards and Technology, 2024).

ENISA reports also underline the evolution of the cyber threat landscape and the need for institutions to strengthen resilience, improve user awareness, and develop effective incident response capabilities. For educational and public institutions, these recommendations are especially important because such organizations manage sensitive data while also maintaining open access to digital services (National Cyber Security Centre, n.d.).

At the regulatory level, GDPR and the NIS2 Directive emphasize the obligation of institutions to protect personal data, ensure cybersecurity governance, and reduce operational risks (European Union, 2016, 2022). Therefore, the literature shows that information security must be approached as a combination of technical, organizational, legal, and human-centered measures.

3. Methodology

This study is based on a qualitative research approach, using conceptual analysis, documentary analysis, and synthesis of specialized literature. The research examines information security challenges in educational and public institutions by analyzing international standards, cybersecurity frameworks, regulatory documents, and relevant institutional practices (International Organization for Standardization/International Electrotechnical Commission, 2022a; National Institute of Standards and Technology, 2024).

The methodological approach includes the identification of common risks affecting institutional networks, the analysis of technical and organizational security measures, and the evaluation of their applicability in institutional environments. The study does not involve empirical data collection, but relies on the interpretation and comparison of existing theoretical and practical sources related to information security management (International Organization for Standardization, 2018; National Institute of Standards and Technology, 2012; Organisation for Economic Co-operation and Development, 2015).

This approach is appropriate because the objective of the article is to provide a structured understanding of contemporary cybersecurity challenges and to identify practical solutions that can be applied in educational and public institutional networks.

4. Results and Discussion

4.1. Specific security challenges in educational and public institutions

Educational and public institutions operate in a digital environment characterized by diversity, openness, and continuous interaction with a wide range of users. Unlike strictly controlled corporate or specialized networks, institutional networks in the public and educational sectors are designed to support accessibility, collaboration, and information exchange. While these characteristics are essential for fulfilling institutional missions, they

also introduce specific challenges related to information security (National Cyber Security Centre, n.d.; Organisation for Economic Co-operation and Development, 2015).

One of the defining features of educational and public institutions is the heterogeneity of their user base. Network access is typically granted to administrative staff, academic personnel, students, external collaborators, and, in some cases, the general public. This diversity complicates the implementation of uniform security controls and increases the likelihood of inconsistent security practices. Users often have varying levels of technical knowledge and awareness, which can result in unintentional security breaches caused by improper handling of information or misuse of network resources.

Another significant challenge is the coexistence of multiple categories of information within the same institutional network. Educational and public institutions manage personal data, academic records, financial information, internal communications, and publicly accessible content simultaneously. The need to balance openness and transparency with confidentiality and data protection creates a complex security landscape. In many cases, sensitive information is processed on the same infrastructure that supports public services, increasing the risk of data exposure if adequate segregation and protection mechanisms are not in place.

Institutional networks are also affected by resource constraints that influence information security practices. Budget limitations, insufficient technical staff, and aging infrastructure can hinder the adoption of advanced security technologies. As a result, institutions may rely on outdated systems or incomplete security solutions that are no longer adequate for addressing contemporary threats. These constraints are particularly evident in public and educational sectors, where investment in information security often competes with other institutional priorities.

The organizational structure of educational and public institutions further contributes to security challenges. Decision-making processes may be decentralized, with individual departments or units managing their own information systems. This fragmentation can lead to inconsistent security policies, overlapping responsibilities, and gaps in accountability. In the absence of centralized coordination, security measures may be implemented unevenly, reducing their overall effectiveness and increasing institutional exposure to risk.

External threats also play a critical role in shaping the security challenges faced by institutional networks. Publicly accessible systems are frequent targets for cyberattacks, including unauthorized access attempts, data extraction, and service disruption. Educational institutions, in particular, are often perceived as attractive targets due to their open environments and extensive user populations. The increasing availability of automated attack tools has lowered the barrier for malicious activities, making even moderately protected networks vulnerable (European Union Agency for Cybersecurity, 2023; MITRE Corporation, n.d.).

In addition to external threats, internal risks must be carefully considered. Insider threats, whether intentional or accidental, represent a significant source of security incidents in institutional environments. Weak access controls, shared credentials, and insufficient monitoring can enable unauthorized actions that compromise information security. These risks are exacerbated in institutions where security responsibilities are not clearly defined or where compliance with security policies is not actively enforced.

Legal and regulatory requirements add another layer of complexity to information security in educational and public institutions. Regulations related to data protection and privacy

impose specific obligations regarding the collection, processing, and storage of information. Ensuring compliance requires not only technical safeguards, but also well-defined procedures and documentation. Failure to meet these requirements may result in legal consequences and loss of public trust, further emphasizing the importance of robust security practices (European Union, 2016, 2022).

Taken together, these factors illustrate that information security challenges in educational and public institutions are multidimensional and closely linked to organizational, technical, and human elements. Addressing these challenges requires a comprehensive understanding of the institutional context and the constraints under which networks operate. Recognizing the specific characteristics of educational and public environments is a necessary step toward developing effective and sustainable information security solutions.

Figure 1 illustrates a conceptual architecture of information security in institutional networks, emphasizing the layered nature of protection mechanisms. The model shows how technical controls, such as network defenses and access management, operate together with organizational policies and monitoring processes to protect information assets. Each layer addresses specific security functions, contributing to the protection of confidentiality, integrity, and availability of information.

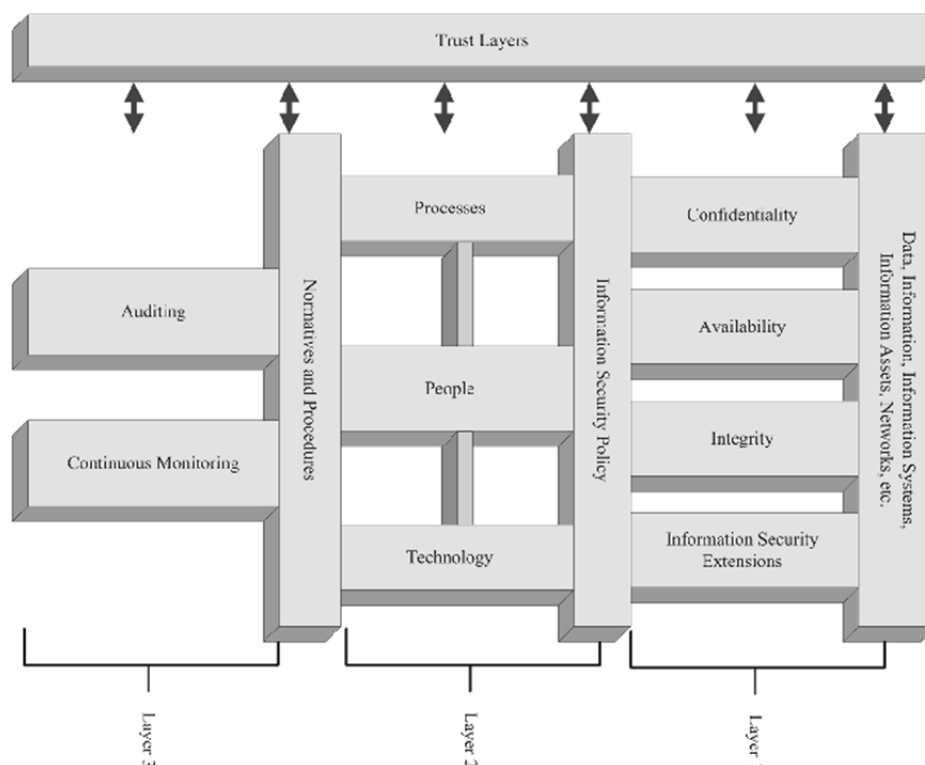


Figure 1. Information security architecture.

Source: Author's elaboration.

The figure also highlights the importance of coordination between technological solutions and institutional procedures. By integrating preventive, detective, and corrective measures, the architecture reflects a comprehensive approach to information security that is particularly relevant for educational and public institutions, where network accessibility must be balanced with data protection requirements.

4.2. Implementation of information security measures in institutional networks

The implementation of information security measures in institutional networks represents a complex and continuous process that must take into account both the specific characteristics of the institutional environment and the evolving nature of cyber threats. Unlike theoretical security models, practical implementation requires adapting general security principles to concrete organizational structures, available resources, and operational requirements. In educational and public institutions, this process is further influenced by the need to maintain accessibility and functionality while ensuring adequate protection of information assets.

A fundamental aspect of implementing information security measures is the establishment of clear access control mechanisms. Institutional networks typically support a large number of users with different roles and responsibilities, making it essential to define access rights in accordance with the principle of least privilege. Users should be granted access only to the information and systems necessary for the performance of their tasks. Proper authentication methods, combined with role-based access control, reduce the risk of unauthorized access and limit the potential impact of security incidents (Center for Internet Security, n.d.; Cybersecurity and Infrastructure Security Agency, 2023b; International Organization for Standardization/International Electrotechnical Commission, 2022b).

Network segmentation constitutes another important measure in securing institutional infrastructures. By separating network resources into distinct segments based on function or sensitivity, institutions can reduce the spread of security incidents and improve control over data flows. Segmentation allows sensitive systems and data repositories to be isolated from publicly accessible services, thereby minimizing exposure to external threats. In institutional environments, this approach supports a balanced coexistence of open services and protected internal resources (Cybersecurity and Infrastructure Security Agency, 2023b; National Institute of Standards and Technology, 2020).

Encryption technologies play a key role in protecting information during storage and transmission. Implementing encryption for sensitive data helps prevent unauthorized disclosure, even in cases where network defenses are breached. In institutional networks, encryption is particularly relevant for protecting personal data, internal communications, and confidential records. The effective use of encryption requires not only appropriate technical solutions, but also clear policies regarding key management and data handling procedures (European Union, 2016; International Organization for Standardization/International Electrotechnical Commission, 2022b; National Institute of Standards and Technology, 2020).

Monitoring and incident detection mechanisms are essential components of information security implementation. Continuous monitoring of network activity enables institutions to identify abnormal behavior, potential intrusions, and policy violations in a timely manner. Intrusion detection and logging systems provide valuable information for responding to incidents and improving security controls. However, the effectiveness of these mechanisms depends on the ability of institutions to analyze collected data and act upon identified risks (Cybersecurity and Infrastructure Security Agency, 2023a; MITRE Corporation, n.d.; National Institute of Standards and Technology, 2024).

Beyond technical measures, organizational and procedural aspects play a decisive role in the successful implementation of information security. Security policies and procedures establish a

common framework for acceptable use of network resources and define responsibilities related to information protection. These documents serve as a reference for both users and administrators and contribute to consistency in security practices across the institution. Without clear policies, technical measures may be applied inconsistently or misunderstood by users.

Staff training and awareness initiatives represent another critical element of implementation. Users are often the first line of interaction with information systems, and their behavior can significantly influence security outcomes. Regular training programs help users understand potential risks, recognize security threats, and comply with institutional security requirements. In educational and public institutions, fostering a culture of security awareness is essential for reducing human-related vulnerabilities (European Union Agency for Cybersecurity, 2019; National Cyber Security Centre, n.d.).

The implementation of information security measures must also include mechanisms for regular evaluation and improvement. Security solutions that are effective at one point in time may become insufficient as technologies and threats evolve. Periodic assessments, audits, and risk analyses enable institutions to identify weaknesses and adjust their security strategies accordingly. This iterative approach supports long-term resilience and helps institutions maintain an appropriate level of protection.

Overall, implementing information security measures in institutional networks requires a coordinated effort that integrates technical solutions with organizational practices and human factors. Effective implementation is not achieved through isolated actions, but through a structured and adaptable process aligned with institutional goals and constraints. Such an approach allows educational and public institutions to address security challenges while preserving the openness and functionality that characterize their digital environments.



Figure 2. Multi-Layer Security Architecture

Source: Author's elaboration based on ISO/IEC 27001:2022, NIST Cybersecurity Framework 2.0, GDPR, and NIST Cybersecurity Framework 2.0.

Figure 2 presents a multi-layer security architecture model that integrates several protective components working together to safeguard institutional networks. The architecture highlights how layered defenses help protect information assets by combining perimeter defenses, access controls, encryption, monitoring, and governance mechanisms into a coherent framework. Each layer corresponds to a category of security controls that collectively enhance the confidentiality, integrity, and availability of data.

The model underscores the interaction between technical controls and organizational policies. It shows that while technical elements such as firewalls, intrusion detection systems, and encryption form essential protective layers, their effectiveness depends on how well they are supported by institutional procedures, user awareness, and continuous monitoring. This layered view reflects the idea that no single control is sufficient in isolation and that robust information security requires coordinated, multi-level protection.

The model is particularly relevant for educational and public institutions, where open access and diverse user populations increase exposure to security risks, and a structured, layered security approach can help balance openness with effective data protection.

4.3. Evaluation of information security effectiveness

The evaluation of information security effectiveness in institutional networks constitutes a complex analytical process through which institutions can understand the real impact of security measures on their digital environments. In educational and public institutions, information systems support not only administrative and operational activities, but also teaching, research, communication, and public services. Under these conditions, evaluation becomes essential for determining whether implemented security mechanisms genuinely contribute to institutional stability or merely create a formal appearance of protection.

Assessing security effectiveness requires an understanding of institutional objectives and operational constraints. Unlike environments governed exclusively by efficiency or profit considerations, institutional networks must support accessibility, openness, and continuity of services. Evaluation therefore cannot be reduced to the simple measurement of technical performance indicators. It must also consider how security measures influence everyday activities, user behavior, and the overall functionality of the institutional infrastructure. Security solutions that are technically robust but poorly aligned with institutional practices may generate workarounds that ultimately weaken protection.

From a technical standpoint, evaluation involves detailed examination of network components, system configurations, access mechanisms, and data handling practices. Institutional networks often evolve incrementally, incorporating legacy systems alongside newer technologies. This heterogeneity increases the likelihood of configuration inconsistencies and hidden vulnerabilities. Through systematic analysis of system logs, access records, and network traffic patterns, institutions can identify weaknesses that do not immediately manifest as incidents but represent latent risks. Such evaluations provide insight into how well security controls perform under real operational conditions, rather than under assumed or ideal scenarios.

Evaluation at the network level also requires attention to interactions between systems managed by different organizational units. In many institutions, responsibility for information systems is distributed across departments, faculties, or administrative divisions. This decentralization can result in fragmented security practices and uneven application of controls. Evaluating the coherence of security measures across the entire network allows

institutions to identify structural gaps, overlapping responsibilities, and inconsistencies that may compromise overall security effectiveness.

Organizational aspects form an equally important part of the evaluation process. Policies, procedures, and governance structures define how security is implemented and enforced in practice. Evaluating these elements involves examining whether security responsibilities are clearly assigned, whether decision-making processes support timely responses to emerging risks, and whether established procedures are realistically applicable in daily operations. In institutional contexts, security failures often stem from ambiguity in roles or insufficient coordination rather than from purely technical shortcomings.

The human dimension of security evaluation is particularly significant in educational and public institutions due to the diversity and fluidity of user populations. Staff members, students, external collaborators, and visitors interact with institutional networks in different ways and with varying levels of awareness. Evaluating the effectiveness of training initiatives, awareness programs, and communication strategies helps institutions understand how security requirements are interpreted and applied by users. Patterns of behavior observed during evaluation can reveal misunderstandings, informal practices, or habitual actions that increase exposure to risk, even when formal policies exist.

Risk-oriented evaluation provides a broader analytical perspective by linking security performance to potential consequences. Institutional environments are subject to changing threat landscapes, technological developments, and regulatory expectations. Evaluation processes must therefore consider not only current vulnerabilities, but also the institution's capacity to adapt to new risks. By correlating evaluation findings with risk assessments, institutions can prioritize improvements and allocate resources in a manner consistent with their strategic objectives and tolerance for disruption (International Organization for Standardization, 2018; National Institute of Standards and Technology, 2012; Organisation for Economic Co-operation and Development, 2015).

Security incidents represent another valuable source of evaluative information. Even incidents with limited impact can reveal important insights into the adequacy of detection mechanisms, response procedures, and recovery capabilities. Evaluating how incidents are identified, reported, and addressed allows institutions to assess the practical effectiveness of their security frameworks. This analysis supports institutional learning and contributes to the gradual refinement of preventive and corrective measures (Cybersecurity and Infrastructure Security Agency, 2023a; National Institute of Standards and Technology, 2024).

Evaluation also plays a role in supporting accountability and transparency within institutional structures. Documented evaluation outcomes provide a basis for informed decision-making at the management level and support compliance with legal and regulatory obligations related to data protection and information security. In public and educational institutions, such documentation also contributes to maintaining trust among stakeholders by demonstrating a systematic approach to safeguarding information resources.

Viewed in its entirety, the evaluation of information security effectiveness in institutional networks is an ongoing and integrative process that combines technical analysis, organizational assessment, and examination of human factors. It enables institutions to move beyond reactive responses to security incidents and toward a more reflective and adaptive approach to security management. Through sustained and context-aware evaluation

practices, institutions can strengthen the resilience of their network infrastructures while preserving the openness and functionality essential to their missions.

5. Conclusions

The analysis presented in this article highlights the complexity of ensuring information security within institutional networks and emphasizes the necessity of addressing this issue through an integrated and context-aware approach. Educational and public institutions operate in digital environments characterized by openness, diversity of users, and evolving technological infrastructures, which creates specific challenges that cannot be effectively managed through isolated technical solutions.

The examination of security challenges demonstrates that institutional networks are exposed to a broad spectrum of risks arising from technical vulnerabilities, organizational constraints, and human behavior. These risks are closely interconnected and often reinforced by limited resources, decentralized management structures, and heterogeneous information systems. As a result, information security in institutional environments must be understood as a multidimensional responsibility rather than a purely technical task.

The discussion on the implementation of security measures shows that effective protection depends on the alignment of technological safeguards with institutional policies and operational practices. Access control mechanisms, network segmentation, encryption, and monitoring tools provide essential protection only when they are embedded within clear procedures and supported by informed and responsible users. In institutional contexts, where accessibility and functionality are critical, security measures must be designed to support rather than hinder legitimate activities.

The evaluation of information security effectiveness emerges as a key element for maintaining and improving institutional security postures. Continuous assessment of technical performance, organizational arrangements, and user behavior enables institutions to identify weaknesses, adapt to changing risks, and refine security strategies over time. Evaluation supports informed decision-making, strengthens accountability, and contributes to institutional resilience in the face of evolving threats.

Taken together, the findings of this study indicate that sustainable information security in institutional networks requires a balanced combination of technical, organizational, and human-centered measures. Institutions that adopt a systematic and adaptive approach to security management are better positioned to protect information assets while preserving the openness and trust essential to their missions. Further research may focus on developing evaluation frameworks tailored to specific institutional contexts and on exploring practical methods for integrating security awareness into everyday institutional practices.

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SUSTAINABLE PRODUCTION MANAGEMENT APPLIED TO COLD FORMING TECHNOLOGIES

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Abstract: *In today's globalization of businesses, the behavior of the industrial consumers registers a change regarding the products available on market. The industrial consumers become increasingly selective when they decide which components are to be integrated into their final products. The trend observed in business processes is to accommodate the former production processes with the sustainability requirements and recommendations. By considering the markets requests, the manufacturers start to develop sustainable products and associated processes considering the entire life cycle of the product. One of the main jobs of the designers is to integrate in all development and production phases the applicable requirements and finally to come in front of customers with a product which satisfies the technical requirements, on one side, and the sustainability requirements, on the other side, without affecting the capability of the product to be used in a safe way. Safety should be considered in an integrative approach related to producer and user, environmental impact and business efficiency.*

Keywords: *sustainability, production processes, cold forming technologies, strategies, management, rethink, material usage rate*

Classification JEL: *O14, L61, M11*

UDC: *[658.5:621.7.016.3]:502.131.1*

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1. Introduction

In today's market the behavior of the consumers registers changes regarding the requested products. Consumers ask for sustainable products, manufactured in a responsible manner and transparency regarding the manufacturing processes and activities. The application of sustainability in production processes involves designing the manufacturing activities in a new approach which considers as an input data the

requirements related to the optimum usage of the raw materials and an indirect input the evaluation of the potential impact on the environment.

Considering the manufacturing processes as business core activities in this paper, a new integrative approach of the processes was studied considering the R Strategies applied in case of cold forming processes of bearings cages. Machining operations occupy an important place in manufacturing technologies because of their practical usage in giving the final shape to the produced part (Pimonev, 2022).

Based on internal supplier-customer approach of activities developed in an industrial company, a flow diagram which shows the integration of R-strategies in business activities was developed. At the same time, the associated customer and manufacturers strategies were identified according to the final scope of the R-strategies. By considering the *Rethink* strategy applicable to the design of manufacturing process phase, a new technological process - which integrates the usage of the waste amount of material from one piece to produce other smaller pieces - was designed. The analyzed methodology was then used to predict the results in terms of material consumption rate, productivity and impact on the standard cost of the analyzed products.

2. Literature Review

Considering the above-mentioned expectations and requests from customers, the producers have in front of supplementary pressure to move forward from their past production systems to approach and implement the more sustainable systems to assure both the technological requirements and the economic results of their activity. In the paper (Manco, 2023) a sustainability-oriented methodology has been developed and applied for two different production strategies: reuse and remanufacturing strategies which are supposed to maintain the original functionalities of the resources, which promotes the circular economy principles, and new productions, both operated through additive manufacturing technologies.

In the paper (Khaled, 2022) a review regarding the studies focused on the sustainability pillars - Economic Sustainability Pillar, Social Sustainability Pillar, Environmental Sustainability Pillar - was presented. By implementing the strategy of transition from the linear approach of manufacturing activities to the sustainable ones, the industrial companies could obtain: the preservation of the resources, the increase of the total efficiency, the optimum energy consumption, the reduction of the emissions, and the minimization of the carbon footprint, the improvement of water consumption and waste management. One of the most important results is the assurance of health and safety at work for entire company personnel. In the paper (Frumusanu, 2017) proposed an efficiency-based classification of manufacturing workstations. The classification method is helpful in process planning, process programming and workstation acquisition.

In the paper (Otero, 2011) a sustainable production system is generally defined as the manufacturing system, usually product-oriented, designed by introducing environmental criteria (eco-design), taking into account not only the product stage of manufacturing, but also considering all life cycle stages, from the obtaining of resources, to the final treatment and recycling once their function as a product is over. In paper (Trost, 2022) models on sustainable production planning and control processes were presented considering the following indicators: the availability of human capital in the context of socially-oriented

production planning, aspects of employee satisfaction, health & safety, utilization of energy and raw materials can be taken into account in the decision-making process in order to assure an adequate and stable supply. In the paper (Afteni, 2021) a study regarding the monitoring and reassessment of suppliers was developed based on the analysis of the supplier performance which consists limited only to quality and delivery performances.

In paper (Realizing the Transition towards the Circular Economy: Models, Methods and Applications, 2020) over the last decade, the “Value Stream Mapping” has been adapted to include more environmental (waste) indicators as part of a growing. In paper (Ortiz, 2025) a systematic literature review regarding the influence of the sustainability factor in production planning was developed. The study mentioned reveals that economic and environmental factors are used more frequently in production planning processes, while an integrative approach of the three dimensions, including the social sustainability, is missing.

In the paper (Hesran, 2019), a review regarding the operations scheduling for waste minimization was developed, the main conclusion being that the incorporation of sustainability aspects into the operational production scheduling can bring substantial improvements without the need for high investments. A classification based on six criteria that embrace the complexity of this topic is made, and various concerns linking scheduling and waste are identified.

In the paper (Pimonev, 2022), a review regarding resource saving by optimization and the machining environments for sustainable manufacturing was developed. The machining process productivity improvement must increase production volume while reducing resource consumption, leading to a more sustainable process.

The paper (Todos, 2022) presents a study regarding the sustainable business development from the environmental, social and governance criteria perspective and conclude that in the last decades the concerns regarding the reduction of the negative effects of industrial processes rise to new concepts that promote the awareness of humanity regarding the interdependencies between economic, political, natural, and social phenomena, at a global level.

The paper (Rastegary, 2025) concerns a study regarding the Assessment of LEVEL(S) Key Sustainability Indicators was developed showing that the LEVEL(S) framework is an important tool for guiding sustainable building design, offering a structured methodology for assessing environmental performance. LEVEL(S) considers qualitative and quantitative metrics, ensuring that both measurable environmental impacts and broader sustainability considerations are accounted for.

Regarding the analysis and management of cold forming processes, a series of studies were performed to identify and propose methods to control the processes, associated equipment and obtained parts. In the paper (Teodor, 2019), it presents the application of statistical process control to a cold forming process. In the paper (Paunoiu, 2022), was studied the 3D scanning’s ability to accurately monitor the die and the corresponding part to reduce design iterations, saving time and resulting in parts that more accurately match to the CAD model.

The paper (Paunoiu, 2024) proposes the kinematic solution for hydraulic press that meets necessary strength requirements and does not involve lengthy assembly or disassembly times. By starting from the limitations of the mentioned literature regarding the integrative approach of the manufacturing activities considering the sustainability indicators in all phases of a product lifecycle, the present paper addresses these points in terms of integrating

the technological criteria, economical criteria and raw material consumption criteria based on R-strategies applied in the case of bearings cages manufacturing processes.

3. Methodology

The present study was developed based on industrial data collected from an industrial company.

Step 1: Design of an integrated flow diagram, figure 1, used then to identify the decisions points and decision owner and the correlation with the identified R-strategies in the case of an industrial product development process and activities.

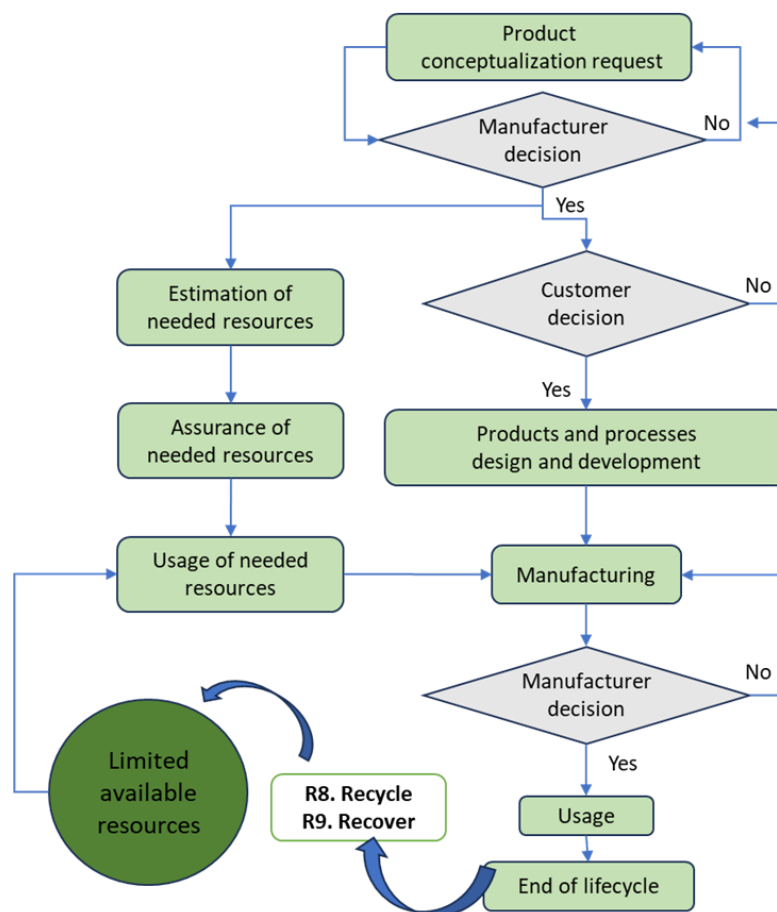


Figure 1. Integrated flow diagram designed for a product development process

Source: Authors' elaboration

Step 2: Identification of the correlation among the product development phases, the decisions points, the decision responsible, the R-strategies and the final scope of decisions considering the input and output in product development processes and phases, according to table 1.

Table 1. The correlation among the decisions responsibility, the product development phases and the R-strategies scope

Customer actions	R-Strategy	Manufacturer actions	Strategy scope
Decides what to buy	R0	Specific to quotation phase	

	Refuse	(select what to be produced)	Decrease the consumption of natural resources.
-	R1 Rethink	Specific to design and development phase	
Decide before placing an order	R2 Reduce	Specific to design phase (products and processes)	Extension of the product lifespan.
Decides based on his own experience and know how	R3 Re-use	Specific to design phase (products and processes)	
Decides based on his own experience and know how	R4 Repair	- Specific to: - after market phase - manufacturing/assembly phase	
Decides based on his own experience and know how	R5 Refurbish	- Specific to: - after market phase	
-	R6 Remanufacture	- Specific to: - manufacturing/assembly phase	
Decides based on his own experience and know how	R7 Repurpose	Specific to manufacturing phases	
Decides based on his own experience and know how	R8 Recycle	- Specific to: - the end of product life cycle	Materials recycling and energy recovery.
Decides based on his own experience and know how	R9 Recover	- Specific to: - the end of product life cycle	

Source: Authors' elaboration based on industrial data collected from Company "Rulmenţi SA", Bârlad

Note: In table 1 the R-strategies were grouped according to their impact on entire product lifecycle – concept – manufacturing – usage – end of life.

- **Step 3:** Selection and usage of *Rethink* R-strategy in the case of a defined product. The study was performed using the *Rethink* strategy applied in the case of the manufacturing process for obtaining a bearing sheet metallic cage. The *Rethink* strategy was applied by considering that the waste material obtained from a cutting process of a part follows to be used as raw material for other smaller parts.

The study was conducted using the data for 1 main product, named in this study P0, from which the waste can be used to manufacture other 2 smaller products, named in this study P1 and P2. The product in which the mentioned part - namely the cage, is used is a spherical bearing composed (according to the picture from figure 2) by: the outer ring, the inner ring, two rows of rollers, the spacer ring and two cages.

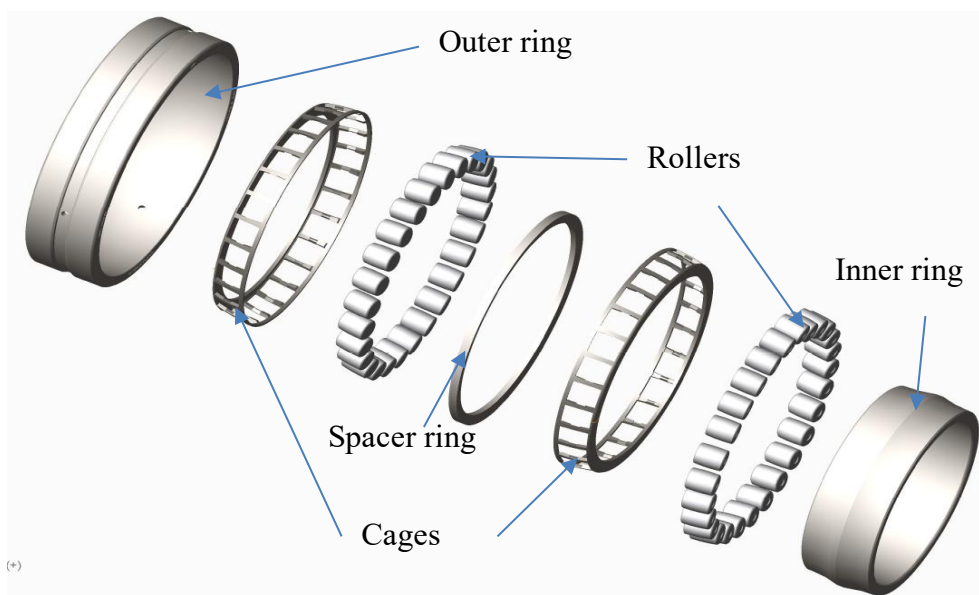


Figure 2. Spherical bearing components - Authors' elaboration based on industrial data collected from Company "Rulmenţi SA", Bârlad

Note: From the components of a spherical bearing, the metallic cage was selected for the here-presented study. Two cages are used in a single bearing.

Step 4: Identification of the manufacturing process steps for a bearing sheet metallic cage. The main manufacturing steps designed and used then in production to manufacture a cage are identified in table 2.

These steps are applicable to product P0, P1 and P2 in case that no Rethink strategy is applied.

Table 2. Manufacturing steps a metallic sheet cage

No.	Manufacturing process steps
1.	Cutting the metallic sheet in strips
2.	Cleaning
3.	Cutting the blank
4.	Stamping the cage
5.	Vibro-smoothing
6.	Cleaning
7.	Face turning I
8.	Face turning II
9.	Vibro-smoothing
10.	Washing and preservation
11.	Packing

Source: Authors' elaboration based on industrial data collected from Company "Rulmenţi SA", Bârlad

Step 5. Identification of sustainability indicators applicable in the case of cold forming technologies. The approach of cold forming process management from sustainable point of view involves the identification of the indicators that can impact on the sustainability of a product and then on the overall company results.

In table 3 the technological criteria, indicators and the sustainability approach are identified from technological point of view. In table 4 the formula used for computation of material usage rate (MUR) indicator and the obtained results in case of the mentioned products are depicted.

Table 3. Correlation among the technological criteria applicable in cold forming process and the sustainability approach

No.	Description of technological criteria	Associated indicator explanation	Sustainability approach
1.	Technological conditions for cut parts	Minimum distance between two perforations / from the edge of the blank to the perforated hole	Consumption of raw material
2.	Technological form	Efficient use of material	
3.	Optimal design of nesting scheme	Maximum possible number of parts at a minimum longitudinal feed step	

Source: Authors' elaboration based on industrial data collected from Company "Rulmenţi SA", Bârlad

Table 4. Computation of material usage rate indicators

Blank Diameter [mm]	Material cutting Indicator [%]	Sheet metal strip usage indicator [%]	Sheet metal utilization indicator [%]
	$K_c = \frac{A_0 r}{B \cdot p} \cdot 100$	$K_f = \frac{A \cdot n}{L \cdot B} \cdot 100$	$K_f = \frac{A \cdot n_t}{L \cdot C} \cdot 100$
166	80,5%	68%	64,9%
176	85,4%	76,5%	72,9%
256	41,8%	48,8%	46,3%
	where: A_0 – area of the cut contour, including holes, in mm ² ; r – number of cutting rows; B – width of the strip, in mm;	where: A – actual cut surface, in mm ² ; n – actual number of pieces obtained (considering end waste); L – length of the strip or sheet metal, in mm; B – width of the strip or sheet metal, in mm.	where: n_t – total number of parts obtained from the sheet; C – sheet width, in mm.

Source: Authors' elaboration based on industrial data collected from Company "Rulmenţi SA", Bârlad

Step 6. Identification of the process phase to be studied from Rethink strategy point of view. The main steps that impact the consumption of raw material in the case of cold forming process is the cutting process. The material consumption in cutting processes depends on:

- Cut part characteristics, as: size, shape, placement on the strip, fiber direction.
- Die design, as: feed limiting system, additional material usage.
- Cutting process, as: inner and outer cutting edges.
- Cutting edge configuration, as: rounded edges, subsequent sectioning.
- Waste recovery, as: reuse of punched material and strip waste.

Step.7. Identification of the associated flow diagram for usage of waste material from one part to manufacture other smaller ones.

4. Results and Discussion

Based on the above-mentioned methodology and steps, the performed study shows the following results in terms of economic impact of the Rethink strategy on products standard cost and productivity, only by Rethinking the input in the case of cold process forming of bearing cages.

4.1. Material usage rate and recovered material

In table 6 it can be observed the impact of Rethink strategy application in the case of cold forming processes of bearing cages. The manufacturing process flow and associated process time and set-up time are improved by using the waste material from cutting phases of the product P0 to manufacture the cages for product P1 or product P2.

The use of Rethink strategy has the main purpose to predict the amount of material and associated costs saved by Rethink the process. In table 5 the percentage of material recovery can be observed by only reporting the diameter of the blank for products P1 and P2 which can be obtained from the blank of P0 product.

Table 5. Predicted percentage of recovered material

Product	Blank diameter [mm]	Recovered material [%]
P1	166	64.8% [166/256]
P2	176	68.7%[176/256]
P0	256	0

Source: Authors' elaboration based on industrial data collected from Company "Rulmenţi SA", Bârlad

4.2. Impact of Rethink strategy on process flow

In figure 3 a simplified flow diagram can be observed for the Rethinked process of cage manufacturing phases.

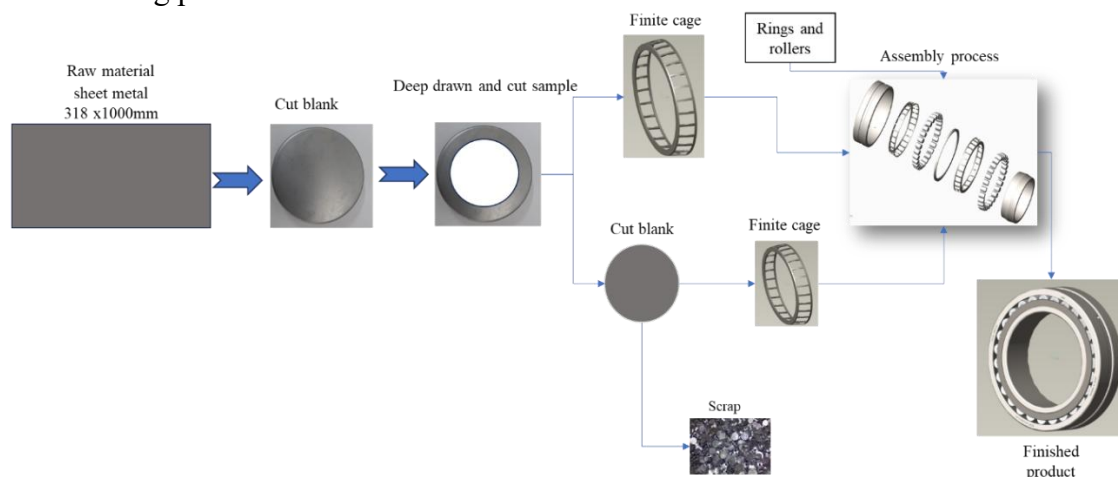


Figure 3. Simplified flow diagram for cold forming process

Source: Authors' elaboration based on industrial data collected from Company "Rulmenţi SA", Bârlad

4.3. Impact on set-up time, processing time and productivity

Table. 6. Comparative evaluation of the results in the case of Rethink application in cold forming processes of bearing cages

No.		Products				
		P0	P1		P2	
			Initial	R think application	Initial	R think application
1.	Number of manufacturing process steps for product P0	11	11	8	11	8
2.	Set-up time [min]	958	712	573	712	573
3.	Processing time [min]	5.6	2.3	1.9	3.4	2.8
4.	Productivity [pcs /hour]	11	26	31	18	21

Source: Authors' elaboration based on industrial data collected from Company "Rulmenţi SA", Bârlad

4.4. Impact on production cost

Considering the application of the Rethink strategy in the above-mentioned conditions and products it can be observed in figure 4 that the application of the proposed methodology could have a significant impact on the production cost of P1 and P2 products.

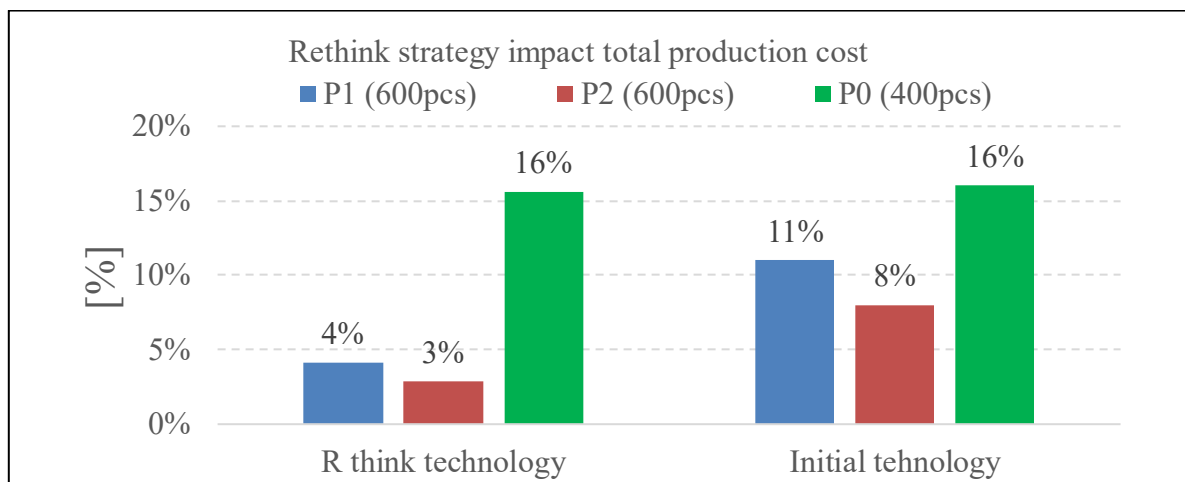


Figure 4. Impact of Rethink strategy application on production cost in the case of cold forming technology

Source: Authors' elaboration based on industrial data collected from Company "Rulmenţi SA", Bârlad

Conclusions

1. Using the sustainability principles in management of different business processes shows several possibilities for overall results improvement.
2. Sustainability approach of manufacturing processes becomes an important element in the transition from a linear to a circular economy in case of all businesses.
3. In the case of manufacturing processes management, some strategies could be used to achieve sustainability expectations.
 - Re-thinking of the technological processes.
 - Analysis of the main consumers at the successive technological steps (set-up, material consumption, dedicated tools);
 - Combination of the technological steps in a way that can use the same quantity of raw material for different parts.

4. A flow diagram with different decision-points related to the R-strategies was identified and can be used in different phases of a product lifecycle management to assure the sustainability of business and product impact.
5. In the case of cold forming processes an indicator of sustainability can be defined as the material usage rate (MUR).
6. To estimate the material utilization rate (MUR), the shape of the blank and the nesting scheme are considered as main parameters.
7. An integrated method was developed to analyze the possibility of raw material consumption improvement in case of bearing cages design and production processes - blanks cutting phase applying the “rethink R strategy” step”.
8. The method was developed with the main purpose of increasing the material usage rate (MUR) by integration of the specific indicators of cold forming processes:
9. Compliance with technological manufacturing conditions,
10. Correlation of the technological shape with next process requirements and technical-economic targets, and optimal design of cutting schemes, and
11. Bringing the amount of consumed material closer to the amount of the finished part.
12. The “rethink R strategy” step was studied in the case of the cutting phase of more bearing cages.
13. The proposed integrated method consisting in using the blank obtained from one cage to manufacture the other smaller cages shows a positive impact considering the following main results:
 - The flow chart is simplified by eliminating 3 main operations: cutting the sheet, cleaning and cutting the blank;
 - The set-up time is reduced from 712 minutes/lot to 573 minutes/lot;
 - The process time is reduced from 1.4 minutes to 1.25 minutes/pcs,
 - The productivity in case of small parts production, considering the yearly average sold bearings in last four years, can be increased by 15÷20%, and
 - The material consumption will be reduced with approximately (65 ÷ 68)%.
14. Regarding future research direction, the obtained results are to be tested experimentally, in a in case of manufacturing other types of bearings cages.
15. The sustainability approaches and principles could and should be applied at different business levels with the purpose of improving the efficiency on long-term.

Acknowledgements:

The study was performed using industrial data collected from Company “Rulmenti SA. ”, Barlad based on the existing collaboration between the Department of Manufacturing Engineering from the Faculty of Engineering, “Dunarea de Jos” University of Galati and the mentioned industrial company.

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INNOVATIVE APPROACHES AND GOOD PRACTICES IN ADVANCING BUSINESS SUSTAINABILITY

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Abstract: *The concept of promoting business sustainability is based on the integration of the principles of environmental protection, social responsibility and economic development of organizations. Having sustainable development means creating long-term profitability, taking into account sustainability requirements. Adopting a strategic decision through which sustainable practices are implemented should represent a major objective for companies that want to reduce their long-term costs, improve their image and develop as much as possible. Using resources for business development, without compromising the chances of future generations to have access to them, represents the concept that manages business sustainability. This can be manifested by implementing innovative directions in order to reduce the impact on the environment. The purpose of the paper is to deepen, from a theoretical and practical point of view, the ways of implementing innovative approaches to promoting business sustainability in the case of organizations in Romania. The main aspects analyzed are highlighted by the approach to the concept of circular economy and the need for reporting in the field of sustainability. The research methodology used is based on the analysis of available public data regarding the country profile of Romania in the field of circular economy. This involved the examination of reports from national and European institutions, as well as studies and analyses carried out by relevant organizations. The results obtained allow highlighting Romania's position in the European context, as well as identifying the main challenges in the field. The conclusions obtained generate useful information for both the business and academic environments.*

Keywords: sustainability, strategy, circular economy, innovation.

Classification JEL: F21, Q56, K32, Q55.

UDC: 005.591.6+[334.72:502.131.1] **DOI:** <https://doi.org/10.53486/ser2026.51>

1. Introduction

Maximizing the challenges that concern environmental, economic and social aspects is an essential reason why sustainability has become an essential element in the development and competitiveness of businesses. The totality of the effects of climate change, the increasing depletion of natural resources and the increasing pressures exerted by consumers and international bodies are all reasons that must lead organizations to rethink their business models by integrating responsible practices into their own activity.

Innovative approaches in promoting business sustainability are the priority theme of the paper and include the integration of digital technologies, the development of ecological products, the implementation of sustainable supply chains and the adoption of business models based on sharing or services. At the same time, good practices highlight the fact that more and more companies are moving towards integrating aspects related to social

responsibility and active involvement in the community into their own strategy, highlighting more and more clearly the opportunities that derive from this type of approach.

The general objective of the paper is to analyze Romania's profile in the field of circular economy, based on public data available on the European Environment Agency website, in order to assess the level of development and identify the main directions of action in promoting business sustainability.

The research is based on public data regarding the country profile on the circular economy of Romania, a profile prepared by the European Environment Agency. The main aspects analyzed are the approach to the concept of circular economy and the use of digital technologies to optimize the activity.

Such an analysis shows its opportunity through the growing importance that the circular economy has in the current economic, social and environmental context, as well as through the need to assess Romania's position in relation to European standards.

Starting from the analysis of the country profile regarding the circular economy, the scientific approach carried out in the paper aims to understand the real level of development of Romania in this field. Given that the European Union is intensely promoting the transition from the linear to the circular economic model, it can be said that it is essential to identify whether and to what extent Romania aligns with these objectives.

The justification for such an analysis also derives from the contribution to identifying weaknesses and existing gaps. Specific indicators, such as the recycling rate or the use of circular materials, highlight the areas in which Romania encounters difficulties, providing a solid basis for formulating public policies that are more efficient.

The analysis carried out in this paper also aims to have an academic value, contributing to the development of specialized literature in the field addressed.

2. Literature Review

Business sustainability is a field that can be considered to have emerged and developed on the identification and synergistic use of concepts from fields such as management, economics, environmental protection and organizational ethics. The specialized literature highlights a gradual evolution of the concept, from corporate social responsibility to the strategic integration of sustainability in the business environment.

2.1. Theoretical aspects of business sustainability

The first references to business sustainability appeared in the mid-20th century, when Bowen (1953) argued in his work that organizations have responsibilities to society that go beyond strictly economic objectives.

Although initially the concerns for identifying and dealing with the impact that economic activities have on the environment did not seem to be a priority for theorists and practitioners in the field, starting with the 1970s and 1980s they began to have an increasing scope, marked by the elaboration of the Club of Rome Report, which draws attention to the limits that natural resources can have and the consequences of future uncontrolled economic development (Meadows et al., 1972)

An important and defining moment for subsequent research is the Our Common Future Report (1987), developed by the Brundtland Commission, a document that introduces the concept of sustainable development and thus creates the conceptual framework for defining and assimilating business sustainability into economic activity.

The theoretical and practical aspects presented in the paper are based on the important moments in which sustainability is integrated into management theory through the definition of stakeholder theory by Freeman (1984) and the definition of the Triple Bottom Line model by Elkington (1997).

Subsequently, established or emerging authors have made important strides in the field, so that today we can base our research on important scientific works. As a conclusion of this retrospective, it can be stated that the foundations of today's modern concepts developed in the specialized literature are based on the synergistic evolution of previous research.

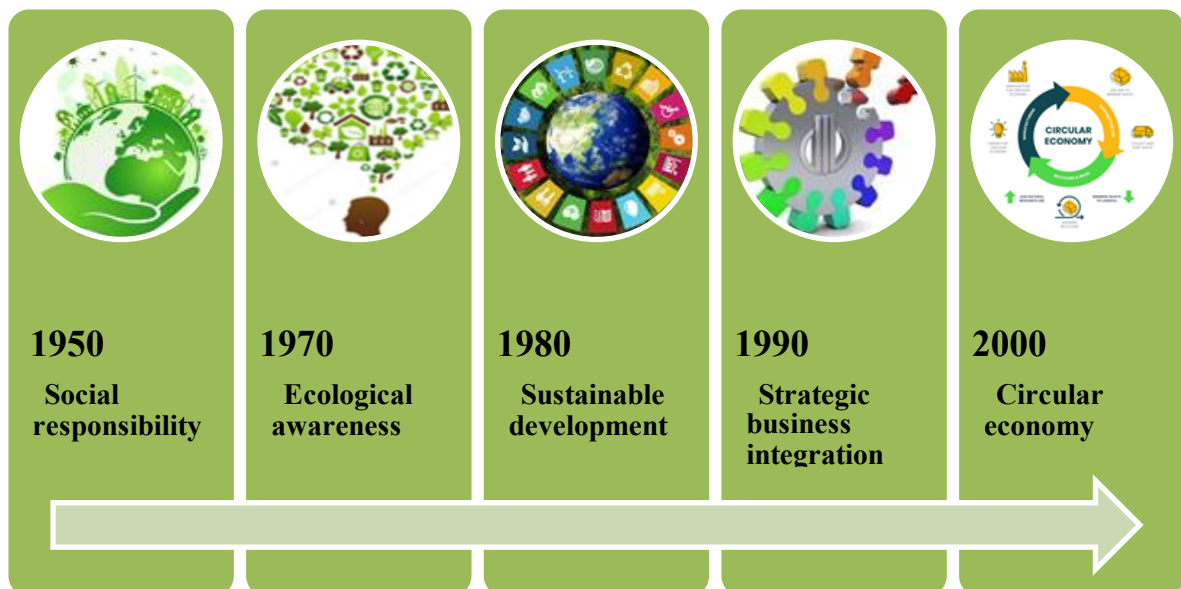


Figure 1. Evolution of concepts in the field of business sustainability

Source: Developed by the author based on literature review

Today it is very clear and well defined that business sustainability focuses on practices that promote the long-term development of the cultural economy, without compromising social, environmental and community aspects (Miu, 2024).

Circular economy is a term with a development over time, accelerated after the 2000s, but which has as an important landmark the definition as an economic system designed to eliminate waste and pollution, keep products and materials in use for as long as possible and regenerate natural systems (Ellen MacArthur Foundation, 2013). All these contributions have made an important contribution to the development of the field.

However, some limits can also be highlighted, identified by:

- overvaluation of the economic dimension: in practice, many organizations tend to maximize their social efforts in order to increase financial performance, placing environmental and social issues in a secondary place.

- difficulties in operationalization: the Triple Bottom Line model is frequently criticized for the lack of well-defined indicators, standardizations and that allow comparisons between the economic activities that are assessed with this model.

Not infrequently, organizations, regardless of their size or the type of activity carried out, may encounter difficulties in implementing the measures that should be taken to simultaneously achieve economic, environmental and social objectives (Hahn et al., 2015).

Recent literature continues to highlight the limitations of the Triple Bottom Line model, especially in the context of new reporting requirements and investor pressure. Studies show that organizations use different metrics, which affects the assessment of sustainable performance (Tsalis et al., 2020).

Based on the analysis of the specialized literature, the main advantages of sustainable approaches identified in recent studies were highlighted (Kraus et al., 2022; Deloitte, 2024). The table 1 presented summarizes these advantages, representing an interpretation of the information extracted from the analyzed sources.

Table 1. The advantages of sustainable approaches in business, based on specialized literature

Advantage	Description	Impact on business
Increasing competitiveness	Differentiation in the market through sustainable practices	Better positioning against the competition
Improving reputation	Positive image and increased trust	Customer loyalty
Reducing costs	Energy efficiency and resource optimization	Higher profitability
Accessing new markets	Attract environmentally conscious consumers	Business expansion
Innovation	Development of new products and services	Long-term growth
Attracting investment	Increased interest in ESG companies	Access to capital
Employee motivation	Increases satisfaction and engagement	Higher productivity

Source: developed by the author on the basis of Kraus et al., 2022, Deloitte, 2024

2.2. Theoretical considerations regarding data reporting in the field of sustainability

Sustainability reporting plays an essential role in assessing organizational performance, influencing both financial results and long-term growth capacity, especially through the management of ESG factors (Oprean-Stan, 2020).

EU policies for environmental protection and corporate transparency include direct references to the need to report business sustainability data to specialized institutions. Data reported through national and European systems ultimately reach the European Environment Agency, an institution that makes these reports public, thus generating a consistent database and information. The EEA is an agency of the European Union that provides independent environmental information to support policies and inform the public. In the specialized literature, the role of the EEA is associated with strengthening environmental governance and improving transparency in

reporting sustainability indicators, contributing to the substantiation of European policies and the implementation of strategic initiatives, such as the European Green Deal (Jordan & Adelle, 2012). Also, reporting sustainability data positively influences investors' assessments and capital allocation decisions (Ioannou & Serafeim, 2015).

The literature on sustainability data reporting is quite extensive and shows the importance of transparent and real data. Research in the field has identified a number of limitations such as the fact that there is still no uniform global framework for sustainability reporting, which affects the comparability and rigor of data (DuToit, 2024).

Taking into account all the aspects previously reflected, it can be concluded that there is a need to deepen research in the field, so that future specialists, theorists and practitioners, have much more resources and tools.

3. Methodology

The research methodology used is based on the analysis of specialized literature and available public data on the country profile of Romania in the field of circular economy. This involved the examination of official documents, reports of national and European institutions, as well as studies and analyses carried out by relevant organizations.

The use of reporting data in the field of sustainability in order to define innovative approaches in the sustainable promotion of business represents the foundation of the research carried out.

The research aimed to deepen the role of promoting business sustainability and the ways in which it is put into practice. Identifying and capitalizing on the advantages offered by the integration of innovative approaches in the sustainable promotion of business represents the main objective of all organizations that are aware of the opportunities in the field (Deloitte, 2024).

The motivation for approaching this research methodology derives from the net advantages offered by the reported data:

- transparency and credibility;
- alignment with European regulations;
- identification of risks and opportunities;
- support for strategic decisions.

The following were mainly analyzed:

- National Strategy on the Circular Economy and Action Plan (Ministry of Environment, Waters and Forests of Romania, 2022);
- Report on Romania's performance in the circular economy (European Environment Agency, 2024).

The analysis was carried out by:

- comparing national indicators with the European Union average;
- identifying the main economic sectors with circularity potential;
- assessing progress and limitations in the transition to the circular economy.

The study of the National Strategy on the Circular Economy is relevant because it provides a perspective on how Romania aligns with European sustainability standards. The analysis of the report on Romania's performance in the circular economy is necessary to assess the efficiency of the implementation of the National Strategy.

4. Results and Discussion

As evidenced by theoretical research, the circular economy is one of the most important approaches to sustainability. In this regard, Romania adopted in 2022 a National Strategy for the Circular Economy, a document that represents the public policy framework for the transition from a linear economic model (extract, produce, throw away) to a circular one.

This serves as a reference document for the government, local authorities and companies in the development of concrete sustainability measures. The National Strategy for the Circular Economy has the role of managing the transition from a linear to a circular economy. This must be done in accordance with the objectives of the 2030 Agenda and the EU Green Deal.

In order to put this strategy into practice, a national action plan was approved that includes 52 priority measures for implementation by 2032, with a focus on governance, circularity measurement, recycling, reuse, waste, water and other essential sectors.

The European Environment Agency report provides an independent assessment of Romania's progress towards a circular economy in the context of European policies, based on the results obtained in the implementation of the National Circular Economy Strategy. Unlike the strategy, which is a government document with directions and commitments, the EEA profile assesses real data on the circularity of the economy, compares Romania with other EU Member States and highlights policy elements, good practices and implementation gaps (European Environment Agency, 2024).

Table 2. Comparative synthesis between the National Strategy for the Circular Economy and the Country Profile of Romania according to the EEA

Aspects	National Strategy for the Circular Economy	EEA Romania Country Profile
What it is	Policy document and strategic plan; defines directions, objectives and measures for the transition to the circular economy	Evaluation and monitoring report; reflects Romania's actual performance in the circular economy compared to other EU countries
Key concepts	Circular business models, sector prioritization, action plan, legislative infrastructure	Circularity of materials, recycling and reuse rates, resource efficiency, good practices, implementation gaps
Key differences	Defines what needs to be achieved; is forward-looking; policy and objective-oriented	Shows what has actually been achieved; is retrospective in nature; focused on data and concrete results
Limitations	Does not automatically reflect real progress; depends on implementation and resources; can be idealistic	Does not offer solutions or action plans; focuses on diagnosis and comparison; may highlight gaps without explaining the causes

Source: National Strategy for the Circular Economy and EEA Romania Country Profile

The analysis of these documents allowed the identification of the concepts that underpinned their drafting, the main differences and the limitations found, these aspects being centralized in Table 2.

The information from the National Strategy for the Circular Economy and the Action Plan allows the identification of sectors with the greatest potential for circularity, those in which materials can be reused, recycled or integrated into sustainable value chains. These are presented in Table 3.

To establish these sectors, the following aspects were taken into account:

- large volume of recyclable materials
- high environmental impact
- technological feasibility for circularity.

The analysis of the priority sectors for the circular economy in Romania, presented in the table, highlights several essential aspects:

- the need for a synergistic approach to legislative, technical and social aspects
- potential for valorization of materials
- economic and ecological opportunities.

Table 3. Analysis of sectors with circularity potential in the context of the National Strategy

Sector	Type of waste / material	Circularity potential	Examples
Construction and demolition	Concrete, brick, metal, wood, insulation	Very high	Recycling of concrete and metals; reusing wood; reducing extraction of natural resources
Agriculture and food industry	Organic waste, packaging, food by-products	High	Compost, biogas, animal feed, reducing food waste
Automotive industry and electrical equipment	Waste parts, batteries, metals	High	Refurbishment of parts, recycling of components
Textiles and clothing	Waste clothing, textiles	Medium to high	Reuse, recycling into fibres, upcycling, second-hand
Paper and cardboard	Waste paper, cardboard	High	Complete recycling for the production of new paper
Plastic and packaging	PET, PE, hard plastic, foil	High	Separate collection, return-deposit schemes, use of recycled and biodegradable materials
Energy and secondary resources	Organic, industrial, municipal waste	High	Production of biogas, heat or electricity through cogeneration

Source: National Strategy for the Circular Economy

In conclusion, it can be stated that Romania has key sectors with high potential, but the success of implementation depends on the coordination of measures, the development of infrastructure and the active involvement of all economic and societal actors.

Relevant aspects from the specialized literature but also the results of our own analysis indicate that the assessment of Romania's progress in the transition to a circular economy requires the identification and monitoring of relevant and quantifiable performance indicators. These indicators allow the measurement of resource efficiency, the degree of recycling and recovery of materials, as well as the comparison of performance with the European Union average and with national strategic targets.

The study of the country profile for the circular economy highlighted the fact that this document provides a series of clear information on how the issue of resource efficiency and the circular economy is approached. The report for Romania was based on information from the National Strategy for the Circular Economy as well as data collected by the European Environment Agency (EEA) and Eurostat. The last published report was produced in 2024 and is based on data from previous years. The indicators highlighted in the report are of major relevance in interpreting the stage of circular economy implementation in Romania. The figures are not very encouraging, hence the need for sustained efforts in this direction.

Table 4. Performance indicators in the circular economy, Romania

Indicator	Valoare / Status	Observații / Implicații
Circular material usage rate	~1,3 % (2023)	Very low compared to the EU average (~12%), indicating under-use of recycled materials and the need to increase recycling infrastructure and policies.
Municipal waste recycling rate	~12–14 % (2022–2023)	Below the EU average (~48%), indicating deficiencies in the selective collection and recovery of municipal waste. Requires education campaigns and incentives for recycling.
Municipal recycling target 2025	55 % (planned)	Ambitious national target; to achieve it, it is necessary to improve infrastructure, legislation and the involvement of local authorities and citizens.
Packaging recycling target 2025	65 % (planned)	Requires the implementation of return systems, incentives for producers and efficient selective collection.
Municipal waste generation per capita	~<350 kg/capita (2022–2023)	Indicator of consumption and prevention; current values show the need for policies to reduce waste and promote reuse.
Dependence on external raw materials	High (estimated)	Indirect indicator; reflects the need to increase the input of recycled materials and autonomy in secondary resources for industry.

Source: EEA Romania Country Profile

The interpretation of the data shows that:

- the available values show in Romania has a low level of circularity, with recycling rates below the EU average.
- targets for 2025 are ambitious and indicate the strategic direction: increasing recycling and valorization of secondary materials

- The indicators allow monitoring progress, assessing the economic and ecological impact, and substantiating political decisions.

Based on the data available at the European Environment Agency level, in order to highlight the need to intensify efforts at the Romanian level, a comparative analysis of the recycling rate of municipal waste was made - Romania and the European Union (2010 vs 2023), the data obtained being presented in the following table.

Table 5. Municipal waste recycling rate – Romania and EU (2010 vs 2023)

Year	Romania – recycling rate (%)	EU average – recycling rate (%)	Comments
2010	Very low (approximately below 5%)	Higher (varied between countries, many states were above 20–30%)	Romania had one of the lowest recycling rates in the EU.
2023	~12 %	~48 % (EU-27)	Romania continues to have one of the lowest rates in the EU; the EU as a whole has almost doubled the rate in 10+ years.

Source: Data available at the European Environment Agency

From the data presented in the table, it can be seen that Romania recorded an increase in the recycling rate between 2010 and 2023, but the absolute level remains one of the lowest in the EU. This reflects challenges on multiple levels – from separate collection and recycling infrastructure, to consumer behavior and local policies.

In order to optimize performance in the circular economy, the need for innovative approaches in the field and the application of good practices is evident.

As could be seen from the analysis of the specialized literature, previous studies have shown the technical and infrastructural challenges, the lack of advanced technologies for waste recycling, an aspect that justifies the current situation of the stage in which Romania is on the path to implementing the circular economy

The current study highlights the fact that, in recent years, Romania has made significant steps in adopting more modern technologies in recycling, such as automated waste sorting and the implementation of solutions for recycling electronic and plastic waste. However, there is still a significant difference between the level in Romania and that in other countries in terms of access to recycling technologies.

4.1. Innovative approaches and good practices in sectors with high circularity potential

Implementing the circular economy requires adopting innovative approaches and promoting good practices at sectoral level.

The implementation of the circular economy in the priority sectors identified by the National Strategy is supported by a series of innovative approaches, which facilitate the transition from the linear economic model to a sustainable one. The main approaches are based on optimizing the use of resources by applying circular business models.

Circular business models represent an important innovative direction, by replacing traditional sales with leasing, rental or refurbishment services. These models contribute to reducing resource consumption and extending the life cycle of products, having a positive impact on the environment and the economy. Digitalization plays an increasingly important

role in supporting the circular economy, by ensuring the traceability of materials and optimizing waste flows. The use of digital technologies allows for efficient monitoring of collection and recycling processes, facilitating decision-making

The development of advanced recycling technologies, including chemical recycling or the recovery of valuable materials from electronic waste, allows for the valorization of waste streams that were previously difficult to manage. In the agricultural and food sector, the valorization of organic waste through composting or biogas production represent effective solutions for reducing waste and regenerating natural resources.

The implementation of modern collection systems, such as those based on guarantee-return or efficient separate collection, significantly contributes to increasing recycling and reuse rates. In Romania, sectors with high circularity potential have started to adopt more and more innovative approaches and good practices that reflect circular economy trends. These include waste recycling, the use of recycled materials, sustainable construction projects and circular fashion, all of which contribute to increasing economic and ecological sustainability.

However, to achieve the ambitious targets set at European level, Romania must accelerate the implementation process of these strategies in each sector. Specifically, Romania is developing innovative approaches and good practices, the following examples justifying the statement:

1. Waste and recycling sector:

- Innovative approaches:

- Improved selective collection through the use of advanced sorting technologies
- Smart recycling platforms that use technology to automatically sort recyclable waste.

- Good practices:

- implementation of recycling awareness campaigns and expanded selective collection systems (campaigns such as “Recycling for a Better Future” – Bucharest, “Be responsible, recycle!” – Cluj Napoca, “We Collect Waste” – Braşov)
- Education and Awareness Projects - Let’s Do It, Romania!:

2. Construction sector

- Innovative approaches:

- innovative modular construction projects that allow the dismantling and reuse of building components, such as recycled concrete slabs, bricks and reusable wood.

- Good practices:

- The Green Building project in Bucharest – sustainable construction using recycled materials and energy-saving technologies

3. Food and agriculture sector

- Innovative approaches:

- Food waste utilization and recycling – transforms food waste into natural fertilizers for organic crops.
- Smart recycling platforms that use technology to automatically sort recyclable waste.
- Good practices:
 - Zero waste project, where food scraps are transformed into compost or fertilizers for your own gardens, and packaging is recycled or reused.

These good practices show that the circular economy is not just a theoretical concept, but can be implemented concretely through innovative solutions that combine technology, product design and sustainable business models, offering economic, social and environmental benefits.

The existence of common regulations and the integration of economic policies at the regional level facilitates the transition to the green economy through two main pillars, namely the energy transition and the circular economy (Apostu et al., 2023).

Innovative approaches and good practice models in circular business can play an important role in implementing a more sustainable economy.

5. Conclusions

The subject addressed in this paper can be considered of interest both for theoreticians in the field and for all interested institutions. The role of the circular economy is well defined by the specialized literature, but any additional research comes to deepen the field and provide new perspectives. Where are we and what should we do in the future in the field of business sustainability? The question should find its answer through the results of the activity of those who develop these concepts.

The circular economy represents an important opportunity for Romania to improve the use of resources, reduce the impact on the environment and support sustainable development. For this to become a large-scale approach, a continuous commitment from the authorities, the private sector and citizens is necessary. In this sense, investments in infrastructure, education and regulations must play an essential role in the success of the national strategy.

The analysis of the information contained in the National Strategy and the Country Profile for the Circular Economy allowed the expression of a clear conclusion regarding the importance of adopting the circular economy, but also that these documents suffer from certain limitations.

These refer to the fact that the implementation plan is insufficiently detailed, the corresponding infrastructure is insufficiently developed, and deficiencies in education and regulation are identified. In order to make the transition to the circular economy a success, it is essential that Romania adopts more concrete measures and implements more visible changes at local and national level.

From the analysis of public data corresponding to the period 2010-2023, it is observed that Romania has recorded a significant increase in the recycling rate, thus making an important step towards approaching the circular economy as a national economic model.

However, progress has not been constant and has varied depending on the regions of the country and the types of waste managed. Access to public data provided by specialized bodies also represents an opportunity that must be maximized by both researchers and bodies and institutions that wish to upgrade information in the field.

In order for these data to be as real and real-time as possible, bodies in all countries should be aware of their importance and provide the requested data in order to produce the most eloquent reports. Based on these reports, national institutions can reorient their economy towards a circular one.

In conclusion, innovative approaches applied in high-potential sectors demonstrate that the transition to a circular economy is possible by integrating technology, sustainable design principles and economic models adapted to new environmental requirements. In this context, the results of future studies and research must focus on understanding the recycling process as thoroughly as possible and identify new directions for improvement for the coming periods.

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COMPARISON BETWEEN THE ROMANIAN EDUCATIONAL SYSTEM AND THE EUROPEAN EDUCATIONAL SYSTEM USING BENCHMARKING ANALYSIS

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Abstract: *Abstract: This article presents a comparative analysis between the Romanian educational system and the European educational system using data at the level of Romania and at the European/Eurostat level, as well as a benchmarking analysis, thus highlighting differences and similarities through the use of relevant statistical indicators. The study examines aspects such as the school dropout rate, the level of education funding, access to education, and students' performance in international assessments. The analysis is based on European statistical data and official reports on the development of education in Romania and in the European Union, analyses published by Eurostat. The results indicate the existence of regional disparities and significant differences with regard to investments in education. They also highlight the challenges related to the quality of the educational process and the equality of opportunities for students. Comparing the two systems allows for the identification of good European practices that can contribute to improving the Romanian system. In this context, the article emphasizes the importance of harmonizing educational policies with European standards. The study highlights the role of public policies in increasing educational performance and also the necessity and importance of educational reforms supported by appropriate strategies and investments. Thus, the research provides a perspective on the development directions of education in Romania in relation to the European space.*

Keywords: *Romanian and European education, rata abandonului şcolar, finanţarea şi accesul la educaţie, educational system.*

Classification JEL: *I21, I28, M10.*

UDC: *37:005.585(498+4EU)* **DOI:** <https://doi.org/10.53486/ser2026.52>

1. Introduction

European education systems are undergoing a continuous process of adaptation to the demands of the knowledge-based economy, the objectives of the European Education Area, and the strategic targets set for 2030. Benchmarking provides a practical instrument for comparing the performance, efficiency, and equity of national education systems, identifying gaps, and extracting transferable best practices.

This paper compares key indicators of the Romanian education system with the EU-27 average, using official Eurostat and OECD data, in order to substantiate public policy recommendations and priority interventions. The aim of the research is to evaluate and compare the performance of the Romanian education system relative to the EU-27 average through the analysis of key indicators (funding, ECEC participation, early school leaving, tertiary education attainment, PISA performance), to identify gaps, validate hypotheses

regarding the relationship between policies and outcomes, and formulate practical and transferable public policy recommendations.

The objectives of the study focus on identifying the most effective practices, models, and educational policies implemented in high-performing education systems at the international level, with the purpose of formulating applicable recommendations for the modernization and improvement of the quality of the Romanian education system.

The novelty of the article lies in the comparison between the Romanian and the European education systems, using specific educational indicators, with the aim of adopting best practices to improve system performance.

Official data show that Romania is below the EU27 average on several structural and performance indicators. This reality justifies a benchmarking analysis that: (1) measures the gaps using normalized indicators; (2) identifies model countries for each domain (ECEC, VET, anti-dropout policies, funding); (3) proposes scalable pilot interventions, accompanied by clear monitoring and evaluation mechanisms.

The structure of the article is as follows: Chapter 1 presents the criteria underlying the benchmarking analysis and the sources used in the comparative analysis; Chapter 2 describes the concept of “benchmarking” and presents the main typologies of benchmarking (definitions, advantages, and relevance for education); and Chapter 3 carries out the research and comparison of the two educational systems using the benchmarking model.

2. Typologies of benchmarking and applicability in education

2.1. Introduction to benchmarking analysis

Benchmarking is a systematic process of comparing performance, processes, and practices with the aim of identifying gaps, extracting best practices, and designing improvements adapted to the local context (Camp, 1989; van Vught et al., 2008). In education, benchmarking supports strategic planning, resource allocation, and the design of targeted interventions (e.g., reducing early school leaving, increasing participation in ECEC, strengthening VET), and it can be applied both at the institutional level and at the system level (Camp, 1989; van Vught et al., 2008).

The concept of benchmarking originates from the term “benchmark” – a reference value that serves as a point of comparison in determining an organization’s current position through surveys (questionnaires) or observations. Benchmarking consists of two components (Kozak, 2004), namely:

- the “benchmarker,” representing the organization that initiates and implements the procedure;
- the “benchmarkee,” referring to the organizations against which comparisons are made (Florea, 2014, *Human Resources Audit*, C.H. Beck).

2.2. Main typologies of benchmarking (definitions, advantages, and relevance for education)

Internal benchmarking

- **Definition:** Comparison between units/subunits within the same organization (schools, campuses, counties).
- **Advantages:** Easy access to data, low costs, higher internal acceptability; useful for the rapid dissemination of best practices.
- **Applicability in education:** Comparing remedial programs or promotion rates among high schools within the same county.
- **Source:** Camp (1989); APQC (n.d.).

Competitive benchmarking (direct external)

- **Definition:** Comparison with similar institutions or systems in other regions/countries.
- **Advantages:** Provides a clear picture of relative positioning; stimulates performance-oriented innovation.
- **Applicability in education:** Comparing PISA results or graduation rates across systems with similar socio-economic profiles.
- **Source:** Burquel & van Vught (2010); APQC (n.d.).

Functional benchmarking

- **Definition:** Comparison of specific functions/processes (e.g., teacher training, human resource management) with organizations performing the same functions, regardless of sector.
- **Advantages:** Enables the transfer of efficient practices from sectors with high operational maturity (e.g., healthcare, industry).
- **Applicability in education:** Adapting a continuous professional development model inspired by best practices in industry.
- **Source:** Elmuti & Kathawala (1997); van Vught et al. (2008).

Generic / best-in-class benchmarking

- **Definition:** Comparison with the best available practices, regardless of sector or context, in order to establish high standards.
- **Advantages:** Identifies ambitious benchmarks; stimulates structural change.
- **Applicability in education:** Analyzing Nordic ECEC models or German VET systems to extract adaptable policy elements.
- **Source:** Camp (1989); van Vught et al. (2008).

Essential distinction: performance benchmarking vs. practice benchmarking

- **Performance benchmarking:** Compares quantitative indicators (KPIs), e.g., early school leaving rates, expenditure per student, PISA scores.

- **Practice benchmarking:** Examines how processes are implemented (processes, policies, training). The combination of both types provides both measurable targets and practical implementation pathways (APQC, n.d.; van Vught et al., 2008).

3. Methodology

3.1. Selection criteria and recommended methodological steps

Selection criteria: strategic objectives, data maturity, available resources, time horizon, and degree of contextual comparability (e.g., curricular structure, funding, demographics). For the Romania vs. EU-27 analysis, the practical recommendation is: (1) piloting through internal benchmarking in representative regions; (2) functional benchmarking for processes (training, VET); (3) best-in-class benchmarking for ECEC policies and inclusion models (van Vught et al., 2008; OECD, 2019).

Methodological steps (operational synthesis):

1. Clearly define the purpose and policy questions.
2. Select comparable indicators (KPIs).
3. Choose the type of benchmarking.
4. Identify benchmarking partners and verify comparability.
5. Collect and validate data (official sources, standardization).
6. Analyze gaps (absolute and relative differences) and conduct qualitative diagnosis.
7. Adapt and pilot best practices.
8. Monitor, evaluate, and recalibrate.

These steps align with the classical benchmarking process model (Camp, 1989) and with guidelines for education systems (van Vught et al., 2008; OECD, 2019).

3.2 Risks, limitations, and ethical good practices

- **“Copy-paste” risk:** Importing a practice without contextual adaptation may fail; critical adaptation is essential (Burquel & van Vught, 2010).
- **Comparability issues:** Socio-economic, legislative, and cultural differences require methodological adjustments (e.g., weighting by GDP per capita).
- **Ethics and confidentiality:** In competitive benchmarking, clear agreements regarding sensitive data and intellectual property must be ensured (APQC, n.d.).
- **Learning-oriented approach (benchlearning):** Prioritize mutual exchange and stakeholder engagement (ministries, inspectorates, schools, unions, employers) to ensure sustainability (Ossiannilsson, 2023).

4. Results and Discussion

4.1 Analysis of the Romanian Education System Using Benchmarking

In order to highlight the differences between the practices applied in the education systems under analysis, several indicators drawn from official European statistics are proposed for comparison (Table 1).

Table 1. Comparative synthesis of the main education indicators, Romania vs. EU-27, 2022–2023

Indicator	România (official value)	UE27 (official value)
Public expenditure on education(% of GDP, 2022)	3,3%	4,7%
Early school leaving (ages 18–24, 2023)	16,6%	9,5%
Participation in early childhood education (age 3 to the start of primary education)	75,7%	94,6%
Tertiary education attainment (ages 25–34, 2023)	≈22–23%	43%
PISA performance (age 15, reading, PISA 2022)	428 points (România)	OECD average ≈ 487

Source: Authors' elaboration based on Eurostat (2024) and Organisation for Economic Co-operation and Development (2023).

The values presented in the table are those officially reported by Eurostat and OECD for the specified years; in the final text, the exact reference year will be indicated for each individual indicator.

Brief interpretation of the indicators

- **Funding:** Romania allocates a share of GDP to education that is significantly below the EU-27 average; this gap constrains investments in infrastructure, equipment, and support programs for vulnerable students.
- **Early school leaving:** The rate of early school leaving in Romania is considerably higher than the EU average, signaling issues related to inclusion, curricular relevance, and support for students from disadvantaged backgrounds.
- **Early childhood education and care (ECEC):** Participation in pre-primary education in Romania remains below the EU average, with long-term implications for basic skills development and equity in educational trajectories.
- **Tertiary education:** The proportion of young people in Romania attaining tertiary education is well below the EU average, affecting the supply of advanced skills necessary for innovation and competitiveness.
- **PISA performance:** Romania's PISA scores (2022) are below the OECD average; these results indicate the need for targeted interventions in functional literacy, mathematics, and science.

Relevance of the comparison and initial implications

The observed pattern (relatively low funding; limited access to ECEC; high early school leaving rates; low tertiary participation; below-average PISA performance) suggests interdependencies: insufficient investment in ECEC and in primary and secondary education may amplify the risk of early school leaving, while the deficit of tertiary graduates constrains the supply of advanced skills required by the labor market.

Benchmarking allows not only the quantification of gaps but also the identification of model countries (e.g., Finland, Estonia, Germany, the Netherlands) whose policies can be adapted to the Romanian context.

The cited data are drawn from official publications and databases:

- Eurostat. (2024). Educational expenditure statistics.
- Eurostat.(2023). Early leavers from education and training.
- Eurostat. Pre primary education participation.
- Organisation for Economic Co-operation and Development. (2023). *PISA 2022 results*.

Table 2. Performance indicators used in the benchmarking analysis

Indicator	România (official value)	UE27 (official value)
Public expenditure on education(% of GDP, 2022)	3,3%	4,7%
Early school leaving (ages 18–24, 2023)	16,6%	9,5%
Participation in early childhood education (age 3 to the start of primary education)	75,7%	94,6%
Tertiary education attainment (ages 25–34, 2023)	≈22–23%	43%
PISA performance (age 15, reading, PISA 2022)	România average 428	OECD average ≈ 487

Source: Authors' elaboration based on Eurostat (2024) and Organisation for Economic Co-operation and Development (2023).

This chapter formulates the research hypotheses of the study, correlates them with the indicators analyzed in the previous chapters, and establishes SMART objectives and the activities required for their validation through a benchmarking analysis. The hypotheses are grounded in official Eurostat and OECD data, which highlight significant gaps between Romania and the EU-27 average in terms of education funding, participation in ECEC, early school leaving rates, and PISA performance (Table 2).

4.2 Research Aim

The aim of this study is to identify the most effective practices, models, and educational policies implemented in high-performing education systems at the international level, in order to formulate applicable recommendations for the modernization and improvement of the quality of the Romanian education system. *"Official data indicate that Romania ranks below the EU-27 average on several structural and performance indicators. Romania allocates a share of GDP to education that is significantly below the EU-27 average; this gap limits investments in infrastructure, equipment, and support programs for vulnerable students."*

SMART Research Objectives

SMART Objective 1 – Validation of Hypothesis 1

- **S (Specific):** Analyze the relationship between educational strategies/policies and early school leaving rates.
- **M (Measurable):** Compare at least five relevant indicators (ECEC participation, early school leaving, socio-educational support, remedial programs, school participation).
- **A (Achievable):** Data available through Eurostat, OECD, and the Ministry of Education.
- **R (Relevant):** Directly related to reducing early school leaving.
- **T (Time-bound):** Completion within 8 weeks.

SMART Objective 2 – Validation of Hypothesis 2

- **S (Specific):** Evaluate the impact of public expenditure on the quality and efficiency of the education system.

- **M (Measurable):** Comparative analysis of three key indicators: public expenditure (% of GDP), PISA scores, and ECEC participation.
- **A (Achievable):** Official data available for Romania and the EU-27.
- **R (Relevant):** Relevant for funding policies.
- **T (Time-bound):** Completion within 6 weeks.

SMART Objective 3 – Identification of Best Practices

- **S (Specific):** Identify at least 10 international best practices that have reduced early school leaving or improved education quality.
- **M (Measurable):** Each best practice documented with outcomes and transferability conditions.
- **A (Achievable):** Feasible through functional and best-in-class benchmarking.
- **R (Relevant):** Contributes to public policy recommendations.
- **T (Time-bound):** 4 weeks.

4.3 Research Hypotheses

Hypothesis 1. The implementation of effective education strategies and policies at the system level significantly contributes to reducing early school leaving in Romania.

Justification: The analysis shows that: "The early school leaving rate in Romania is significantly above the EU average, indicating issues related to inclusion, curricular relevance, and support for students from disadvantaged backgrounds." This suggests that well-calibrated education policies (ECEC, support for vulnerable students, remedial programs) can contribute to reducing early school leaving.

Hypothesis 2. The level of public expenditure allocated to the education system directly influences its quality, and increased public investment leads to improved efficiency in the functioning of the Romanian education system.

Justification: The analysis emphasizes that Romania allocates a share of GDP to education that is significantly below the EU-27 average; this gap constrains investments in infrastructure, equipment, and support programs for vulnerable students. This financial gap affects the quality of educational processes and student performance.

4.4 Research implementation stage

For the purpose of conducting the research, five key indicators were selected for the analysis of the education system in Romania and the EU-27. These indicators are frequently used in European-level educational research (Eurostat), namely:

1. **Public expenditure on education (% of GDP, 2022)** – measures the share of public resources allocated to the education system relative to the size of the economy in 2022, both for Romania and as an average across EU-27 countries;
2. **Early school leaving (ages 18–24, 2023)** - indicates the percentage of young people who have not completed secondary education in Romania and in the EU-27 (expressed as an average percentage);

3. **Participation in early childhood education (age 3 to the start of primary education)** – measures children’s access to pre-primary education services in Romania and in the EU-27;
4. **Tertiary education attainment (ages 25–34, 2023)** – reflects the proportion of young people holding a university degree in Romania and in the EU-27;
5. **PISA performance (age 15, reading, PISA 2022)** – indicates the level of reading competencies among 15-year-old students in Romania and the EU-27.

The benchmarking analysis aimed to transform the initial values of the five selected criteria into a scalar assessment on a scale from 1 to 5, corresponding to the percentages obtained in the first stage. Accordingly, values were assigned to each indicator, and these were recorded in tabular form, with Romania marked as “X” and the EU-27 as “0” (Table 3).

Table 3. Scaled values obtained for the benchmarking analysis

No. Criterion	Obtained value	1	2	3	4	5
1				X	0	
2		X			0	
3				X		0
4		X		0		
5					X	0

Source: Authors’ calculations based on Eurostat (2024) and Organisation for Economic Co-operation and Development (2023).

The results obtained enabled their representation in the form of a diagram, highlighting the major differences between the compared education systems in terms of the five criteria used (Figure 1).

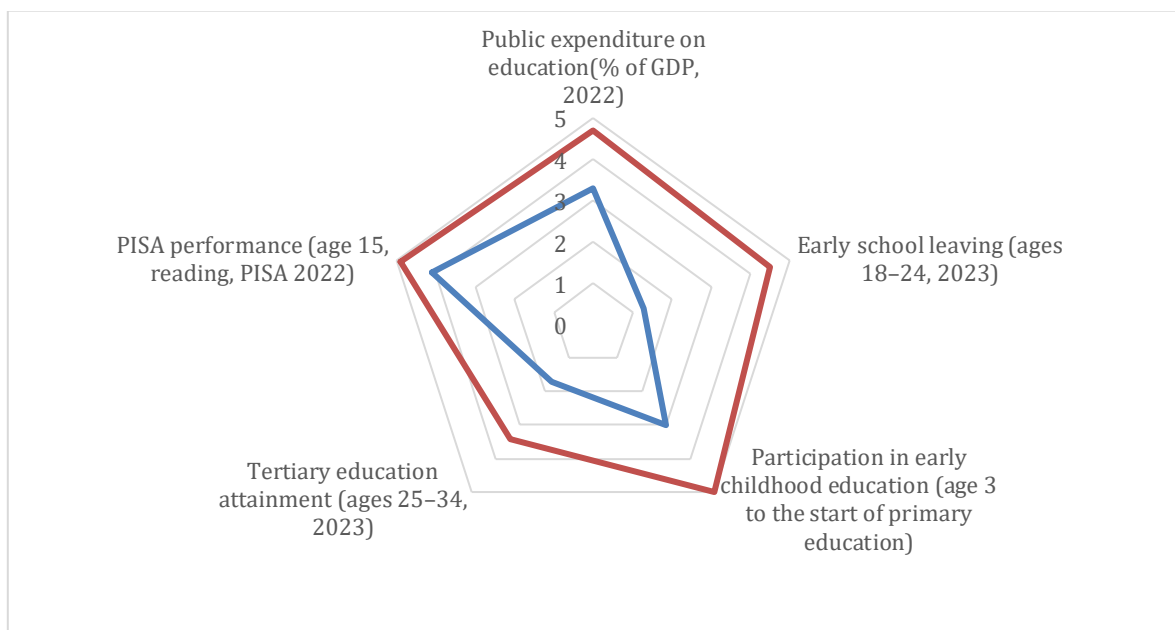


Figure 1. Graphical representation of the differences identified following the analysis of the five selected criteria, Romania vs. EU-27

Source: Authors’ representation based on benchmarking calculations using Eurostat (2024) and Organisation for Economic Co-operation and Development (2023).

Interpretation:

1. **Public expenditure on education (% of GDP, 2022)** – measures the share of public resources allocated to the education system relative to the size of the economy. **Romania: 3.3%, EU-27: 4.7%.** A lower share of public expenditure indicates limited resources for infrastructure, salaries, and educational programmes, which may negatively affect both the quality and equity of the education system.
2. **Early school leaving (ages 18–24, 2023)** – indicates the percentage of young people who have not completed upper secondary education. **Romania: 16.6%, EU-27: 9.5%.** A high level of early school leaving reflects issues related to student retention, the relevance of the educational offer, and socio-economic barriers that **Participation** reduce opportunities for employment and further training.
3. **In early childhood education (age 3 to primary school entry)** – measures children's access to pre-primary education services. **Romania: 75.7%, EU-27: 94.6%.** The significant gap in participation suggests deficiencies in access, limited ECEC system capacity, and territorial inequalities, with long-term effects on early skills development.
4. **Tertiary education attainment (ages 25–34, 2023)** – reflects the proportion of young people holding a university degree. **Romania: approx. 22–23%, EU-27: 43%.** The low tertiary attainment rate may limit labour market competitiveness and innovation capacity, despite relatively higher shares in certain fields (e.g., STEM) in Romania.
5. **PISA performance (age 15, reading, PISA 2022)** – indicates reading competency levels among 15-year-old students. **Romania: average 428, OECD average $\approx$ 487;** the results indicate significant underperformance and high levels of inequality in educational outcomes. PISA results highlight the need for **reforms in initial and continuous teacher training, curriculum design, and inclusion policies** in order to reduce gaps compared to EU/OECD averages.

4.5 Operational activities**A. Data collection and standardization**

- Extraction of Eurostat and OECD data for the analyzed indicators.
- Verification of comparability (definitions, reference years, methodologies).
- Construction of a unified Romania–EU-27 database.

B. Gap analysis

- Calculation of absolute and relative differences for each indicator.
- Identification of the areas with the largest gaps (ECEC, early school leaving, funding, PISA).
- Correlation of indicators to identify potential causal relationships (e.g., funding $\rightarrow$ performance).

C. Functional and best-in-class benchmarking

- Selection of model countries (Finland, Estonia, the Netherlands, Germany).
- Analysis of policies that have reduced early school leaving or improved education quality.

- Assessment of transferability to the Romanian context.

D. Hypothesis validation

- Testing the relationship between policies and early school leaving (Hypothesis 1).
- Testing the relationship between funding and quality (Hypothesis 2).
- Triangulation with qualitative data (studies, reports, interviews).

E. Formulation of recommendations

- Development of a set of short-, medium-, and long-term recommendations.
- Definition of monitoring indicators.
- Proposal of pilot interventions.

4.6 Conclusions based on indicator analysis

The analysis of Eurostat and OECD indicators confirms the relevance of the formulated hypotheses:

1. **Hypothesis 1** is supported by the fact that Romania records an early school leaving rate of **16.6%**, significantly above the EU-27 average (**9.5%**).
 - Low participation in ECEC (**75.7%** vs **94.6%**) and the lack of support programmes contribute to early school leaving.
 - Effective policies in model countries show that early interventions significantly reduce dropout rates.
1. **Hypothesis 2** is supported by the significant funding gap:
 - Romania: **3.3% of GDP**
 - EU-27: **4.7% of GDP**

This deficit affects infrastructure, teaching quality, and PISA performance (**428 points** vs OECD average of **487**).

2. **The interdependencies** between indicators confirm that:
 - adequate funding → improved access to ECEC → reduced early school leaving → higher PISA performance → increased participation in tertiary education.
3. **Benchmarking** enables the identification of successful models that can be adapted to Romania, particularly in the following areas:
 - early childhood education,
 - anti-dropout policies,
 - teacher training,
 - predictable funding mechanisms.

5. Conclusions

In order to improve the performance of the Romanian education system, based on the five indicators considered, several specific measures for analysis and improvement are proposed.

- **Insufficient funding:** Romania allocates **3.3%** of GDP to education (2022), below the EU-27 average of **4.7%**, which limits investments in infrastructure, staff, and support programmes.
- **High early school leaving:** The early school leaving rate in Romania is **16.6%** (2023), significantly above the EU-27 average of **9.5%**, indicating issues related to inclusion and curricular relevance.
- **Below-average ECEC access:** Participation in early childhood education (age 3 to primary school entry) is approximately **75.7%** in Romania compared to **94.6%** in the EU-27, with long-term implications for equity.
- **Below-average PISA performance:** Romania's average PISA reading score (2022) is approximately **428** points, below the OECD average of approximately **487**, confirming the need for interventions in foundational competencies.

5.1 Recommendations

- **Short term:** Pilot expansion of ECEC programmes in regions with low coverage; strengthening remedial programmes in primary education.
- **Medium term:** Gradual increase in public expenditure on education towards the EU-27 level, with dedicated allocations for ECEC and anti-dropout measures.
- **Long term:** Structural reforms for continuous teacher training and the implementation of monitoring systems for impact assessment (longitudinal evaluations and impact studies).

Research limitations

- **Aggregated data and local heterogeneity:** National indicators may mask urban/rural or regional disparities; sub-national data are needed for operational recommendations.
- **Temporal and methodological comparability:** Differences in reference years and definitions across sources may affect gap estimations; further standardization is recommended.
- **Risk of unadapted transfer:** Best practices from other countries must be adapted to the Romanian institutional and financial context to avoid implementation failure.

5.2 Future research directions regarding benchmarking and the Romanian education system

In the context of globalization and increasing international competition, both organizations and education systems are required to continuously adapt their strategies in order to respond to ever-changing demands. Benchmarking, as a tool for comparative analysis and performance improvement, provides a relevant framework for developing future research directions, particularly in relation to the Romanian education system.

A first important research direction concerns **the systematic integration of benchmarking within educational institutions**. Although this tool is well established in the economic sector, its use in education remains limited and fragmented. Future studies could analyze how educational institutions can adopt best practice models from other high-performing systems, identifying relevant performance indicators such as graduation rates, graduate employability, or the level of acquired competencies. In this regard, research should

highlight the mechanisms through which benchmarking can become an operational tool, not merely a theoretical one.

A second relevant direction is **the comparative analysis of the Romanian education system with other European or international systems**. Periodic comparative studies can contribute to identifying structural and functional differences, as well as highlighting strengths and weaknesses. Such research could focus on aspects such as curriculum design, teaching methods, teacher training, or the level of digitalization. The results could provide a foundation for more effective education policies adapted to contemporary realities.

Another relevant direction is **the assessment of the impact of benchmarking on education quality**. It is necessary to investigate the relationship between the application of this tool and the improvement of institutional performance. Future research could examine whether institutions that adopt benchmarking practices achieve better results in terms of student satisfaction, academic performance, or managerial efficiency. Additionally, it could explore how benchmarking contributes to the development of an organizational culture oriented toward performance and continuous learning.

Closely related to this, **the role of technology and digitalization in educational benchmarking emerges** as another research direction. The use of digital platforms, databases, and advanced analytical tools can facilitate the collection and interpretation of relevant data. Future studies could explore how artificial intelligence, big data, or integrated information systems can support comparison and evaluation processes, thereby improving the accuracy and efficiency of decision-making.

Furthermore, an insufficiently explored area concerns **the adaptation of benchmarking to the cultural and organizational specificities of the Romanian education system**. International models cannot always be implemented directly without contextual adjustments. Therefore, future research should analyze contextual factors influencing the success of such practices, such as organizational culture, available resources, or the level of institutional autonomy. Such an approach would enable the development of benchmarking models adapted to local realities.

Another important direction concerns **the involvement of educational stakeholders in the benchmarking process**. Teachers, students, parents, and institutional managers play a crucial role in the implementation and success of these practices. Future studies could analyze the level of acceptance and involvement of these actors, as well as their impact on decision-making processes. In this context, research on the development of managerial competencies required for the effective use of benchmarking is also relevant.

Finally, there is a clear need for research on **the alignment of benchmarking with public education policies**. Integrating this tool at the macro level through national strategies could contribute to increasing the coherence and efficiency of the education system. Future studies could analyze how benchmarking results can inform educational reforms, resource allocation, or the establishment of quality standards.

In conclusion, benchmarking offers significant potential for improving the performance of the education system; however, its effective use requires in-depth research adapted to the specific context. The future directions outlined above emphasize the importance of an integrated approach that combines comparative analysis, innovation, and adaptation to local

realities. In this way, it is possible to contribute to the development of a more efficient, competitive, and performance-oriented education system.

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FLUVIAL TOURISM CORRIDORS FOR SUSTAINABLE DEVELOPMENT AND ECONOMIC RESILIENCE IN THE REPUBLIC OF MOLDOVA

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Abstract: *In the context of global economic and climatic transformations, sustainable tourism represents a key instrument for enhancing regional economic resilience. River networks, as components of natural infrastructure, can function as tourism corridors that connect natural and cultural resources at the territorial level, thereby contributing to the sustainable use of space. This article examines recent European models of the touristic valorization of river networks and identifies opportunities for the Republic of Moldova, taking into account local specificities and the orientation toward sustainable development.*

Keywords: *Moldova, inland waterway network, corridor, river corridor, tourism.*

Classification JEL: *L83, L89, M29, O10, O52.*

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1. Introduction

The river network of the Republic of Moldova is entirely integrated within the Black Sea drainage basin and is structured around two major fluvial systems – the Dniester River and the Prut River – complemented by a dense network of small and medium-sized rivers and streams. In total, this network comprises approximately 3,621 watercourses, with a cumulative length of around 16,000 km (Vasilean et al., 2024). Morphologically, the majority of these rivers are typical lowland systems, characterized by reduced channel gradients, pronounced meandering patterns, low flow velocities, and extensive floodplains. The prevailing northwest–southeast flow direction is controlled by the regional geomorphological structure, which has facilitated the development of wide, mature valley systems.

The mean density of the hydrographic network is estimated at 0.57 km/km², displaying notable spatial variability (Cazac et al., 2003). Higher densities are observed in the northern sector of the Dniester – Prut interfluvium, where increased terrain fragmentation and higher precipitation levels prevail, whereas lower densities characterize the southern and southeastern regions, marked by more arid climatic conditions and a comparatively sparse drainage network. This hydrographic configuration exerts a significant influence on territorial development patterns. Despite the apparent agricultural potential associated with low-relief landscapes and fertile soils, the interfluvium areas shaped by internal river systems remain underutilized, reflecting structural constraints related to limited accessibility, insufficient infrastructure, and suboptimal resource integration.

2. Literature Review

Recent literature on river systems increasingly emphasizes their role beyond hydrological functions, positioning them as integrated spatial structures that support transport, tourism,

ecological connectivity, and regional development. This shift is reflected in both European policy frameworks and academic studies, which conceptualize rivers as multifunctional corridors embedded in territorial systems rather than isolated natural elements (European Commission, 2024b; Inland Navigation Europe, 2025).

A significant strand of research focuses on the development of fluvial tourism and river corridors as instruments of sustainable regional development. Cooper and Prideaux (2009) highlight that river tourism has evolved into a distinct segment of the tourism industry, characterized by slow mobility, experiential travel, and strong links with local landscapes and cultural heritage. This perspective is reinforced by studies on the Danube, which demonstrate how river cruises and waterfront development contribute to regional economic growth and the valorisation of cultural resources along the corridor (Danilović Hristić et al., 2020).

At the European policy level, the development of transnational river corridors such as the Rhine–Danube Corridor illustrates the importance of integrating inland waterways into multimodal transport networks. The European Commission emphasizes that such corridors are essential components of the TEN-T network, ensuring connectivity, economic cohesion, and sustainable freight transport across the European Union (European Commission, 2024a, 2024b). In this context, rivers are treated as strategic infrastructure that supports both economic efficiency and territorial integration.

From a geographical and environmental perspective, river systems are also understood as dynamic ecological networks. The literature on water resources in the Republic of Moldova highlights the importance of hydrological balance, sedimentation processes, and seasonal variability in determining the functional capacity of rivers (Cazac et al., 2003; Vasilean et al., 2024). These studies underline that the usability of rivers for navigation and tourism depends not only on physical characteristics but also on environmental management and infrastructure development.

Furthermore, UNESCO-related conceptual frameworks on cultural corridors provide an important theoretical background for understanding rivers as spatial axes of interaction. These frameworks stress the continuity of exchange, mobility, and cultural transmission along historical routes, which can be reinterpreted in contemporary contexts as foundations for tourism and regional development strategies (Cultural Corridors of South East Europe, 2005).

Overall, the literature converges on the idea that river corridors function as multidimensional territorial systems, combining transport infrastructure, tourism potential, cultural heritage, and ecological value. However, their effective development depends on navigability conditions, infrastructural investment, and integrated territorial planning, which remain uneven across different regions.

3. Methodology

This research employs a qualitative-descriptive methodology combining content analysis of policy documents and scientific literature with direct field observations in Moldovan riparian localities. The research also integrates a SWOT analysis to synthesize internal and external factors influencing river tourism development. Comparative case studies from EU countries are used as best practice models.

4. Results and Discussion

Dysfunctions and Constraints in the Socio-Economic Valorization of the River Network of the Republic of Moldova

The territory of the Republic of Moldova is located within the Dniester – Prut interfluvium. The analysis of demographic and socio-economic indicators reveals the presence of pronounced structural imbalances within this interfluvial space, characterized by a predominance of rural areas.

The data highlight the existence of significant territorial disparities among the development regions of the Republic of Moldova. First, the predominance of rural areas at the national level (57%) is evident, with even higher values recorded in the South (68%) and Centre (65%) regions, confirming the predominantly agrarian character of the interfluvial space (Biroul Național de Statistică, n.d.).

Table 1. Socio-Economic Indicators by Development Regions, 2024

Region	Population	% Urban	% Rural	Density (inh./km ²)	Average Monthly Income (MDL)	Employment Rate (%)
North	870,000	38	62	85	8,000	38
Centre	980,000	35	65	95	8,500	39
South	650,000	32	68	70	7,800	37
Gagauzia	155,000	35	65	85	9,000	41
Chişinău	720,000	85	15	1,100	15,000	48
Total	~2,430,000	43	57	83	~10,000	40

Source: NBS, <http://statbank.statistica.md>

The Chişinău region clearly stands out from the rest of the country through its high level of urbanization (85%), very high population density (1,100 inhabitants/km²), and significantly higher average monthly income (15,000 MDL), reflecting the concentration of economic activities and infrastructure in the capital.

In contrast, the North, Centre, and South regions register lower income levels (7,800-8,500 MDL) and lower employment rates (37-39%), indicating a lower level of economic development and limited employment opportunities. The South region appears to be the most vulnerable, with the lowest population density and the lowest income levels. Although Gagăuzia records a relatively higher average income compared to other rural regions, it remains characterized by a predominantly rural structure and a moderate level of employment.

Overall, these data reflect a polarized development model, in which the capital concentrates economic resources, while the interfluvial regions remain marked by insufficient development, pronounced rurality, and limited access to economic opportunities.

The hydromorphological characteristics of the river network of the Republic of Moldova condition its functional profile, which includes:

- maintenance of biodiversity;
- provision of drinking water;

- irrigation;
- supply of industrial and domestic water;
- wastewater discharge;
- transport;
- tourism.

According to the National Bureau of Statistics, the largest share of water abstracted from natural reservoirs (approximately 70% of total use) is allocated to drinking water supply, with over 70% of this volume being consumed by the population. The remaining water consumption is attributed primarily to industrial uses, including wastewater discharge and other economic activities (Biroul Național de Statistică, n.d.).

Fluvial transport, permitted only on certain river segments, accounts for a negligible share - less than 1% of total freight transport and approximately 0.03% of passenger transport in the Republic of Moldova. The statistical data highlight several important structural aspects:

- Inland waterway transport has an extremely low share. In 2025, a total of 131.2 thousand passengers were transported by water, compared to 333 million passengers in total public transport, representing approximately 0.04%;
- Freight transport on Moldova's inland waterways amounted to 140 thousand tonnes in 2025, accounting for only 0.7% of the total volume of goods transported. By contrast, road transport dominates, representing approximately 87% of the total freight volume in the Republic of Moldova. These figures reflect the marginal role of inland navigation within the overall structure of the national transport system.

Table 2. Status of Inland Waterway Transport in the Republic of Moldova

Indicator	2024	2025	Remarks
Passengers transported (thousand persons)	128.2	131.2	slight increase
Passenger traffic (million passenger-km)	0.26	0.26	very low level
Freight transported (thousand tonnes)	≈138	≈140	minimal variation
Freight turnover (million tonne-km)	≈0.28	≈0.28	stable level
Total passengers in public transport (all modes)	307.6 million	333.0 million	inland waterways have a negligible share
Total freight transported (all modes)	≈20 million tonnes	20.2 million tonnes	road transport dominates

Source: National Bureau of Statistics of the Republic of Moldova – Passenger and Freight Transport (2024–2025) <https://statbank.statistica.md/>

Based on official reports issued by national institutions (such as the Agency “Apele Moldovei,” the Ministry of Environment, and the National Bureau of Statistics) (Agenția

„Apele Moldovei,” n.d.; Biroul Național de Statistică, n.d.), as well as field observations, the underutilization of the river network can be attributed to several key factors:

- insufficient investment in river maintenance and related infrastructure;
- sedimentation processes and inadequate depths for large vessels;
- fragmentation of agricultural land and limited access to riverbanks;
- administrative and political changes.

Table 3. SWOT Analysis – Utilization of the River Network of the Republic of Moldova

Strengths (S)	Weaknesses (W)
- Dense hydrographic network integrated into the basins of the Dniester River and Prut River - Multiple functional roles: drinking water supply, irrigation, biodiversity support, tourism - High landscape and ecological value (floodplains, meanders, wetlands) - Existing navigable sections for small vessels - Strong natural and cultural heritage potential of riparian areas - Potential for urban river corridor regeneration (e.g., Bâc River basin)	- Extremely low inland waterway transport share (below 1% of freight and ~0.03% of passenger transport) (Biroul Național de Statistică, n.d.) - Frequent sedimentation and shallow depths, especially in small rivers - Insufficient tourism, port, and navigation infrastructure - Pollution and environmental degradation in urban river sections - Limited access to riverbanks and fragmented land ownership - Underutilization of economic and transport functions
Opportunities (O)	Threats (T)
- Development of fluvial tourism corridors for regional revitalization - Increasing demand for ecotourism and recreational tourism - Integration of riverine settlements into tourism networks - Access to European funding for sustainable development projects - Low-cost potential for tourism development - Development of sustainable mobility and eco-tourism routes	- Climate change impacts (droughts, reduced river discharge) - Persistent urban and industrial pollution - Progressive loss of navigability due to sedimentation - Lack of consistent investment in water infrastructure - Depopulation of rural riverine areas - Agricultural pressure on river ecosystems

Source: compiled by the author

In order to improve the economic conditions of riverine areas and facilitate their integration into broader economic circuits, a strategic reorientation toward the tourism-based valorization of the river network is required. This approach relies on the utilization of existing natural resources without necessitating major infrastructure investments. In this way, tourism capitalizes on the intrinsic attractiveness of these areas while preserving their ecological and landscape characteristics. The SWOT structure highlights a clear imbalance between the high natural potential of the river network and its current low level of economic and tourism utilization. In this context, the development of fluvial tourism corridors represents a feasible and strategically justified direction for the Republic of Moldova.

Tourism corridor concept

The concept of the cultural corridor, introduced in 1974 by the Romanian professor Răzvan Theodorescu, designates historical territorial axes in South-East Europe along which cultural values, ideas, and innovations have continuously circulated (Cultural Corridors of South East Europe, 2005, p. 2). These corridors are not simple transport routes, but rather evolutionary structures that reflect long-term interactions between communities and civilizations, encompassing both tangible and intangible dimensions. They are multifunctional and polythematic, integrating various forms of cultural, economic, and social exchange.

From the perspective of the evolution of this concept, the tourism corridor can be understood as an operational and contemporary form of valorizing a territorial axis of connectivity, in which the cultural-historical dimension is transformed into an economic and functional product.

Thus, the tourism corridor represents a system of interconnected destinations, attractions, and tourism services linked by transport infrastructure and organized along a geographical or thematic axis. In contrast to the cultural corridor, which is primarily historical, identity-based, and associated with collective memory, the tourism corridor is oriented towards the management of visitor flows, economic development, and the territorial integration of tourism resources.

It preserves the spatial logic of the cultural corridor - namely continuity, interaction, and connectivity - while adapting it to contemporary objectives such as increasing territorial attractiveness, diversifying the local economy, and reducing regional disparities. In this sense, the tourism corridor becomes a spatial planning instrument that transforms historical and geographical axes into functional networks for sustainable tourism development.

European Fluvial Corridors: Best Practices and Development Models

Fluvial corridors represent strategic spatial development axes that capitalize on waterways as natural infrastructure for connectivity between regions, cities, and ecosystems. In the contemporary European context, they have evolved from simple navigation routes into integrated systems of transport, tourism, and territorial development, where economic, cultural, and environmental functions are closely interlinked.

In particular, European fluvial corridors are designed as multimodal and multifunctional structures in which inland navigation, river tourism, riparian cultural heritage, and urban regeneration simultaneously contribute to territorial cohesion and sustainable development. Examples such as the Rhine, Danube, and Seine demonstrate how rivers can function as regional integration axes and platforms for sustainable mobility and thematic tourism.

In this regard, the analysis of best practices in European fluvial corridors provides a relevant framework for understanding the mechanisms of efficient valorisation of hydrological resources and for identifying applicable models in regions with similar potential, but currently underutilized.

Table 4. Best practices of fluvial corridors in Europe

Fluvial corridor	Countries involved	Best practice model	Main functions	Key success factors
Rhine–Danube Corridor	France, Germany, Austria, Slovakia, Hungary, Romania, etc.	Multimodal TEN-T corridor	transport, tourism, connectivity	EU integration, port infrastructure, improved navigability, developed river tourism
Rhine River Corridor	Switzerland–Germany–Netherlands	River tourism + logistics	cruises, freight transport	high urban density, cultural heritage (medieval cities), high accessibility
Danube Corridor	Germany–Austria–Romania–Bulgaria	tourism and geopolitical corridor	tourism, navigation, culture	capital cities (Vienna, Budapest, Belgrade), UNESCO heritage, cruise tourism
Seine Corridor	France	urban-tourism corridor	urban tourism, mobility	integration of Paris with rural heritage, urban river tourism, regeneration projects
Elbe Corridor	Germany–Czech Republic	cultural-natural corridor	tourism, limited transport	natural landscapes, Berlin–Prague connection, slow tourism
Douro Corridor	Portugal–Spain	wine-tourism corridor	niche tourism	viticulture integration, thematic cruises, regional development

Source: compiled by the author

The analysis of European fluvial corridors highlights the existence of three main development models:

1. **The multimodal integrated model (Rhine–Danube).** This is the most complex model, combining freight transport, cross-border mobility, and tourism. It functions as a strategic European infrastructure system with a major economic role.
2. **The cultural-tourism model (Danube, Rhine, Seine).** This model capitalizes on urban and rural heritage, focusing on cruises, historic cities, and cultural experiences. It is the most developed in terms of river tourism.
3. **The specialized/natural model (Elbe, Douro).** Here, ecotourism and thematic functions (wine, landscape, nature) prevail, with a lower regional economic impact but a strong identity value.

Overall, the success of fluvial corridors depends on three key factors: consistent navigability, integration of multimodal infrastructure, and the valorisation of riparian cultural heritage. European fluvial corridors represent advanced models of integrated territorial development, in which rivers are no longer merely natural axes but become complex economic, tourism, and cultural structures. The European experience shows that their effective valorisation generates both regional economic growth and territorial cohesion. These models can be adapted to regions such as the Republic of Moldova, where fluvial potential remains insufficiently exploited.

Fluvial Tourism Corridors in the Republic of Moldova

The proposed structuring of the river network of the Republic of Moldova into functional corridors highlights a significant potential for differentiated valorisation of watercourses, depending on their hydrological characteristics and territorial context (Beţivu, 2018). From

this perspective, the Nistru and Prut rivers can be regarded as primary development axes, while the Răut and Bâc rivers play a secondary, predominantly local and ecological role.

Table 5. Fluvial Corridors Proposed for Moldova's River Network Development

River / Corridor	Length in the RM (km)	Main segment	Hydrological characteristics (discharge / average depth)	Navigability potential	Recommended activities	Constraints / limitations
Nistru	636–657	From Soroca to the Black Sea outlet	Mean discharge: 318 m ³ /s; average depth: 2–4 m	Light navigation possible with small vessels along most sections	Cruises, canoeing, kayaking, sport fishing, ecotourism routes	Seasonal droughts, sedimentation in lower sections, lack of port infrastructure
Prut	695	From Criva (RO–MD border) to the Danube confluence	Mean discharge: 70–90 m ³ /s; average depth: 1.5–3 m	Limited navigation with small vessels, mainly in central and southern sections	Canoeing, leisure boating, nature-based tourism	Land fragmentation, frequent droughts, sedimentation, small-scale ports
Răut	286	From headwaters to the confluence with the Nistru	Mean discharge: 6–8 m ³ /s; average depth: 0.5–1 m	Difficult navigation, suitable only for small canoes during wet seasons	Canoeing, local fishing, recreational activities along riverbanks	Severe sedimentation, navigable only seasonally
Bâc	155	From urban sources to the confluence with the Nistru	Mean discharge: 1–2 m ³ /s; average depth: 0.3–0.8 m	Impossible navigation	Urban riverside walks, local recreational activities	Sedimentation, pollution, unstable flow, lack of infrastructure

Source: compiled by the author

The main advantage of this approach lies in transforming rivers from passive geographical elements into active structures of territorial development. In the case of the Nistru, its high discharge and considerable length allow the development of a multifunctional fluvial corridor, particularly for recreational tourism, water sports, and small-scale cruises. This can generate direct economic benefits through increased tourism attractiveness, as well as indirect benefits through the development of related services in riverside settlements.

The Prut complements this system through its potential for slow tourism and ecotourism, supporting low-impact activities such as canoeing and nature-based tourism. In this way, it contributes to diversifying the tourism offer and connecting rural communities to alternative economic circuits, thereby helping to reduce territorial disparities.

In the case of the Răut and Bâc rivers, although navigability is limited or absent, the main benefit lies in their potential for ecological regeneration and integration into local

recreational space, particularly in urban areas. These watercourses can support the development of green infrastructure, pedestrian routes, and leisure areas, contributing to an improved quality of life.

Overall, the implementation of the fluvial corridor concept in the Republic of Moldova offers three major benefits: the efficient use of existing natural resources with relatively low investment requirements, the stimulation of sustainable tourism, and the reduction of territorial disparities through the integration of riverine regions into economic and recreational networks. This differentiated approach enables each river's functions to be adapted to its actual potential, maximising both economic and environmental outcomes.

5. Conclusions

The river network of the Republic of Moldova shows a differentiated potential for structuring into tourism corridors, where the Nistru and Prut rivers function as primary axes due to their favorable hydrological characteristics and recreational navigation potential.

The Nistru corridor stands out as the most complex and valuable, offering conditions for the development of diversified fluvial tourism (cruises, kayaking, sport fishing), while the Prut plays a complementary role, mainly oriented towards slow tourism and ecotourism activities.

Secondary watercourses, such as the Răut and Bâc rivers, have limited navigational potential; however, they can be valorised through local recreational functions and ecological regeneration projects, including the development of urban green spaces.

The main constraints affecting the development of fluvial corridors include sedimentation, seasonal variations in water flow, lack of access infrastructure, and anthropogenic pressure, all of which significantly reduce their current economic and tourism utilization.

Overall, the proposed fluvial corridors can contribute to the diversification of the national tourism offer and to balanced territorial development, provided that differentiated interventions are implemented in accordance with the specific potential of each watercourse.

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THE STRATEGIC ROLE OF ITSM IN MODERN EDUCATION SPHERE

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Abstract: *This research analyzes the strategic role of IT Service Management (ITSM) in the context of the modern educational shift toward hybrid and online learning models. It argues that the transition from traditional methods necessitates a fundamental paradigm shift, where IT infrastructure evolves from a reactive support unit into a user-oriented strategic service. By analyzing the implementation of global frameworks such as ITIL 4, this study demonstrates how higher education institutions can effectively align their technological resources with their core academic missions. This research reveals how ITSM optimizes critical workflows, ranging from the initial stages of student enrollment to the complex task of securing sensitive research data. Functioning as a sophisticated orchestration system, ITSM ensures that technical requests are routed efficiently and that critical incidents are prioritized to maintain institutional continuity. This approach allows faculty members to dedicate their efforts to pedagogical delivery and innovation rather than being hindered by technical troubleshooting or connectivity issues. Furthermore, the research shows that ITSM serves as the indispensable backbone of contemporary education, transforming the IT department into a proactive strategic partner. By fostering a culture of continuous improvement and service value, universities can build more resilient and scalable digital environments. Ultimately, the primary beneficiary is the student, who receives a seamless, high-quality digital experience that is essential for achieving academic excellence in today's increasingly digital-first landscape.*

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Keywords: *IT Service Management (ITSM), ITIL 4, Digital Transformation in Education, Hybrid Learning, Academic Continuity, Strategic IT, User Experience (UX).*

Classification JEL: A20, I21, I25, O32

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1. Introduction

Nowadays, significant attention is being paid to the implementation and subsequent effective operation of information systems in educational institutions. The implementation of information systems in education is aimed at the digital transformation of the learning process, the management of schools, colleges, and universities, as well as improving the quality of education. The digitization of education involves all areas of educational institutions operations - from classroom instruction to administrative management - enabling the transition to modern educational standards.

The implementation of ITSM approach in the educational environment transforms the IT department into one of the most active units. It is important to provide educational institutions with 24/7 access to data and to ensure a more personalized and comprehensive learning experience for students. Fostering a culture of continuous service improvement ensures the sustainability of the digital ecosystem of schools, colleges, and universities, which ultimately enhances the quality of service for students.

These systems offer cloud deployment with greater storage and processing capabilities; the number of features built into the system can also increase, making it easier to meet all

requirements, from student enrollment to alumni network support - tasks that would otherwise be tedious and labor-intensive.

The pandemic was the catalyst for the development of this type of system. According to data published by UNESCO, 1.3 billion students worldwide were unable to attend school during the pandemic. Many schools, colleges, and universities were closed worldwide. Since educational institutions were completely closed during the pandemic, demand for solutions such as information systems for students and learners increased sharply around the world.

2. Literature Review

A significant contribution to this field has been elaborated by many researcher from many countries. Since its appearance in the 1980s, ITIL 4 (Information Technology Infrastructure Library) has become the most important methodology for IT service management; its latest version, ITIL 4, was released in 2019. It has been successfully implemented in small, medium, and large enterprises worldwide, enabling the creation of effective IT service management practices. The importance of ITIL lies in its ability to account for the unique infrastructure and requirements of each organization, meeting both business needs and stakeholder expectations. Researchers have recognized its significance and worked to adapt ITIL best practices to various organizations, including higher education institutions, demonstrating its versatility and impact.

The academic discourse surrounding the digital transformation of higher education has increasingly shifted from purely technical implementations to strategic service management. Central to this transition is the adoption of the ITIL framework, which redefines IT as a value-creation engine rather than a support function. For example, researcher Otari Machaladze from the Georgian Technical University (Tbilisi, Georgia) in his research focuses on the optimization of IT infrastructure within complex academic environments (Machaladze, 2025). In his studies, the researcher argues that the effectiveness of modern universities is directly proportional to the maturity of their IT service management processes. He emphasizes that the transition to ITIL 4 allows institutions to move away from "reactive" troubleshooting toward a "proactive" service model that anticipates user needs.

Expanding upon the theoretical foundations, another example of practical ITSM application is provided by Haneen Khalid Ibrahim and Ibrahim Ismael Hamarash (2025). In their study focused on universities within the Kurdistan Region of Iraq, the authors transition from the general philosophy of ITIL to the specific challenge of its technical execution. They address a fundamental problem that many educational institutions face: the fact that while ITIL 4 offers a vast library of 34 practices, it does not provide a "one-size-fits-all" instruction for which ones to implement first.

On the national level, this problem is being studied in considerable detail. A further localized perspective on these challenges is offered by Adrian Andronic (2023), who provides a comparative analysis of digital transformation in Moldova and Estonia. While the aforementioned studies focus on the technical and process-oriented aspects of ITIL, Andronic shifts the focus toward the strategic and financial sustainability of these systems. His research evaluates the "Education Strategy 2030" (Ministry of Education and Research, 2023) in Moldova, identifying the effective implementation of digital technologies as the primary vehicle for ensuring the quality and resilience of the national education system.

Despite the diverse geographical and methodological approaches of the analyzed studies - ranging from the strategic comparative analysis of Andronic, the philosophical frameworks of Machaladze, to the empirical process-selection models of Ibrahim and Hamarash - a singular, cohesive scientific consensus emerges: the paradigm shift from "IT as a Support Function" to "IT as a Strategic Value Driver."

This common conceptual thread, which also forms the cornerstone of the current research, posits that the digital maturity of a modern educational institution is no longer defined by the mere presence of technical tools (such as Moodle, SIME, or SIS), but by the integrated orchestration of these tools through an ITSM framework.

By aligning the national strategy of the Republic of Moldova with these international findings, this study confirms that the implementation of ITIL 4 practices is not merely a technical upgrade, but a critical prerequisite for achieving sustainable, high-quality education that meets the demands of the 21st century.

3. The main goal and the methodology

The purpose of this research is to analyze the role of ITSM in the modern education sphere worldwide, inclusive and the Republic of Moldova and analysis of top ITSM companies, as: Ellucian Company LP, PowerSchool Group LLC, Workday Inc., Oracle Corporation, Campus Management Corp.

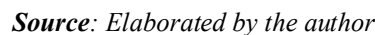
The following researches methods were used in this research: analysis, synthesis, comparative analysis, logical method, monographic method, statistical data analysis, etc.

The analysis in this study is based on data from the latest Mordor Intelligence™ report - "Student Information Systems Market Size and Share Analysis-Growth Trends and Forecasts (2024-2029)" and on opinion of experts in the education and IT sectors, as well as ITSM companies.

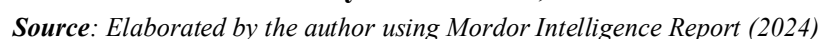
4. Results and Discussion

The student information system offers features such as monitoring relevant student information, streamlining communication between staff and faculty, enabling the tracking of student information during the admissions process, providing registration and reporting tools, and more. Stakeholders at educational institutions benefit from the system because the amount of paperwork is significantly reduced and complex tasks are simplified.

The student information systems market is segmented by type - solutions, services; end user - education levels, higher education; by deployment method - on-premises, cloud; and by geographic region - North America, Europe, Asia-Pacific, Latin America. By type of solutions and services, the three main ITSM categories in education are Assessment Information Systems, Administrative Information Systems, and Learning Management Systems.



The demand for this type of product is primarily due to the increasing digitalization of education, the growing trend toward e-learning, and a focus on improving the quality of education (Mordor Intelligence, 2024).



For example, the University of Nottingham, which is one of the largest and most complex organizations, comprising three campuses around the world: in the UK, China, and Malaysia. It is the seventh-largest university in the UK, with 8,000 staff members and 46,000 students. The university has implemented Oracle PeopleSoft Campus Solutions across all three campuses. All three campuses now use a single integrated system, which is expected to increase efficiency, reduce costs, and improve the user experience for both staff and students.

For example, India's school education system is the largest in the world, comprising more than 1.5 million schools, over 8.7 million primary and secondary school teachers, and more than 260 million students. It is home to the world's largest and most complex education system, serving over 260 million young people annually, making it a region with enormous opportunities for student information system providers to penetrate and expand their customer base.

The leading global companies involved in the development of student information systems are: Ellucian Company LP, PowerSchool Group LLC, Workday Inc., Oracle Corporation, and Campus Management Corporation.

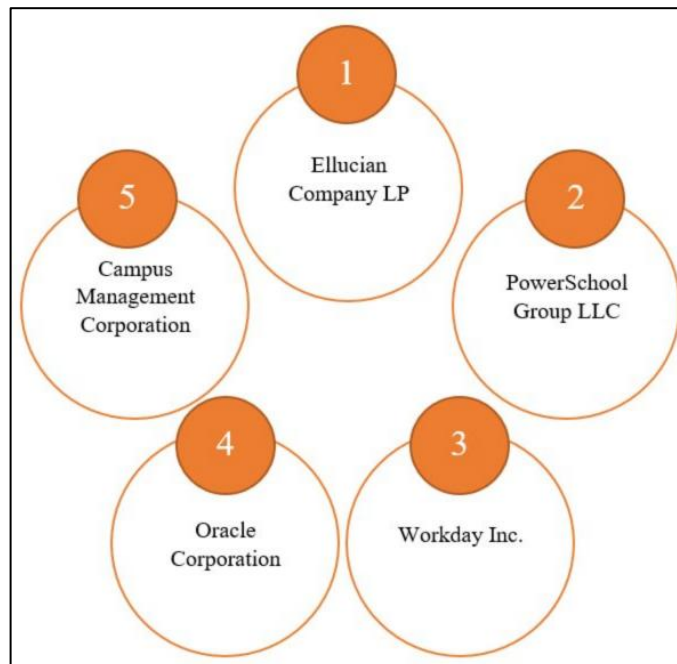


Figure 3. Market leaders in student information systems (SIS)

Source: Elaborated by the author using Mordor Intelligence Report (2024)

- **Ellucian Company L.P.** is a leading global provider of technology solutions for higher education. The company develops software and provides services that help educational institutions manage the entire student lifecycle: from recruitment and enrollment to graduation and fundraising. The modern Ellucian was formed in 2012 through the merger of Datatel and SunGard Higher Education. Ellucian offers a comprehensive AI-powered SaaS platform that includes: its flagship ERP systems, Banner and Colleague, used for managing academic records, enrollment, and course schedules; solutions for automating accounting, budgeting, and human resources management at universities; tools for managing scholarships and financial aid (e.g.,

following the acquisition of CampusLogic); and systems for recruiting and engaging prospective students and alumni. The company's clients include more than 3,000 higher education institutions in 50 countries worldwide. More than 21 million students use the company's services. In 2026, Ellucian was named one of Fast Company's most innovative companies in the "Education" category (Ellucian, n.d.).

- **PowerSchool Group LLC** - is the world's leading technology platform for K-12 education. The company provides cloud-based software that integrates administrative processes, classroom instruction, and family engagement. PowerSchool offers a comprehensive ecosystem of solutions divided into several "clouds": its flagship student information system (PowerSchool SIS), as well as enrollment and reporting tools; learning management systems (Schoology Learning) and a performance assessment platform (Performance Matters); PowerBuddy - an AI assistant - integrated into various products to support teachers in lesson planning, assist students with learning, and provide analytics to parents; tools for staffing (Unified Talent), financial planning (Allovue), and teacher professional development (PowerSchool, n.d.).
- **Workday Inc.** - is a leading U.S.-based provider of cloud-based enterprise applications (SaaS) for financial management, human capital management (HCM), and planning. Founded in 2005, the platform serves thousands of organizations worldwide, including more than 45% of Fortune 500 companies, enabling the digital transformation of HR and financial processes.
- **Oracle Corporation** - is one of the world's largest American technology companies, founded in 1977. It ranks second in revenue among software manufacturers, behind Microsoft, and specializes in database management systems (DBMS), cloud services, enterprise applications (ERP, CRM), and server hardware.
- **Campus Management Corp.** (now part of Anthology) is an American company specializing in the development of software for higher and secondary education. It provides cloud-based ERP systems (CampusNexus Student Information Systems, CRM, and financial management), helping educational institutions manage the student lifecycle from admission to graduation.

In the Republic of Moldova, the two main IT systems being implemented in universities are Moodle, and in schools and colleges - SIME (the "Sistemul Informațional de Management în Educație"), which serves as the central pillar of educational ITSM. The integration of SIME and Moodle transforms the national education system from a reactive model to a proactive, strategic one. SIME and Moodle optimize and enhance the quality of teaching and learning, administrative efficiency, and data-driven decision-making.

Moodle - is a software product that allows users to create online courses and websites. It is an ongoing project. The first version of the system was launched in 1999 by Martin Dougiamas, a student from Australia. The word "Moodle" is an acronym for Modular Object-Oriented Dynamic Learning Environment, a term most useful to programmers and theorists. Moodle competes on equal footing with the global leaders in the e-learning market. An international team of developers has been working on the system for over 10 years, under the leadership of the Moodle Foundation in Australia.

As a result, Moodle combines a wealth of features, flexibility, reliability, and ease of use. The system is widely known around the world, has over 60,000 installations in more than 100 countries, and has been translated into dozens of languages. The system scales well: there are installations serving up to a million users. The Moodle LMS is designed for creating and delivering high-quality distance learning courses. Moodle is focused on collaboration. The system provides a wide range of tools for this purpose: wikis, glossaries, blogs, forums, and workshops. At the same time, learning can take place both asynchronously, when each student studies the material at their own pace, and in real time, by organizing online lectures and seminars. The system supports the exchange of files in any format - both between instructors and students and among students themselves.

The Education Management Information System (SIME) was launched in 2017 by the Ministry of Education, Culture, and Research of the Republic of Moldova and is the first national online platform providing access to education data. The Education Management Information System is a project initiated by the Ministry of Education in collaboration with the Center for Information and Communication Technologies in Education, district education departments, and schools across the country, and was implemented thanks to a grant from the World Bank.



Figure 4. Open Data Portal: Information Management System in Education

Source: Screenshot of the home page SIME

The program was developed to automate the processes of collecting, updating, and storing data related to the country's general education system. SIME data are used by officials at the institutional, district/municipal, and national levels for strategic planning, monitoring education, and identifying children who have dropped out of school, children at risk, and children with special educational needs.

5. Conclusions

The SIS market growth reflects a fundamental shift in the educational sphere where data driven decision making and administrative efficiency are no longer optional luxuries but institutional necessities. As the Student Information System market matures, several key takeaways emerge regarding the future of academic management.

The projected valuation of \$23.26 billion is largely driven by the migration from legacy on-premise hardware to scalable cloud environments. This shift allows institutions to reduce capital expenditure while gaining the agility needed to support remote and hybrid learning models. Furthermore, modern systems are evolving beyond simple record keeping. By integrating predictive analytics and artificial intelligence, these platforms now offer early intervention triggers for at-risk students and automated workflows that reduce administrative burnout.

As the ecosystem expands, the focus is shifting toward seamless interoperability between information systems and learning management platforms. With the rise in cyber threats targeting educational data, market growth will be contingent on the implementation of robust security frameworks.

In conclusion, the anticipated 14.19 % compound annual growth rate underscores a global commitment to the digital transformation of education. For institutions to remain competitive through 2029, they must view these systems as the central nervous system of the academic enterprise, capable of fostering student success and ensuring long-term institutional resilience.

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DESCRIPTION OF THE BASIC PRINCIPLES OF OPERATION OF THE ACCOUNTING COMPONENT OF THE SPECIALIZED SOFTWARE 1C: ACCOUNTING

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Abstract: *Technology is a priority partner for the accounting profession, designed to assist in the recording of economic transactions characteristic of an organisation's core activities, supported by documentary evidence, in strategic decision-making on data recording, storage and analysis, and in risk management. The 1C Accounting system can be used to maintain any accounting sections at enterprises of various types. The purpose of this article is to review and describe the basic principles of operation of the Accounting component of the 1C Accounting system, as well as to review examples of working with the system. The information presented is a brief description of the concepts of the 1C Accounting system that the user of the programmed operates with in the process of using the system. Among the concepts listed below, the basic (general) concepts of the 1C Accounting system will be highlighted, as well as concepts relating exclusively to the Accounting component.*

Keywords: *Software, 1C Accounting system, constants, reference books, supporting documents, journals, reports.*

Classification JEL: *M40, M41, C88.*

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1. Introduction

This article examines the fundamental principles of accounting implemented by the Accounting module of the 1C:Enterprise system, as well as techniques for working with the system, describes examples of how to use the software, which, at the domestic level - after authorized specialists have made various modifications to the configuration of purchased or imported programs to ensure compliance with current national legislation – can be purchased as derivative products on the domestic market under the name 1C: Accounting.

The relevance of this article, which marks the start of a series of publications describing the basic principles of operation of the Accounting module within the specialised 1C: Accounting - a product developed and distributed on request in the domestic market by authorised companies - is driven by the need to automate the workplace, which involves the

use of modern technologies, including the optimisation of work processes leading to the minimisation or elimination of manual work, the effective organisation of accounting work, ensuring the timely entry and processing of business transactions; minimising the delegation of tasks to a larger team within the finance department, which entails significant staff costs; minimising routine work with documents supporting the organisation's business transactions; minimising errors in the analysis of the enterprise's activities from an accounting perspective and in final reporting to the relevant state authorities; reduction or elimination of penalties imposed by tax authorities, as well as other measures necessary to improve the efficiency of accounting work processes through the use of specialised information systems, developed in accordance with modern programming languages and based, in particular, on the National Accounting Standards, International Financial Reporting Standards, etc.

This article is intended both for users of the information system who are responsible for its operation such as accountants, payroll officers, configuration specialists, students during their studies and for users who work with a limited set of the programme's functions, including operators, managers and company directors.

2. Literature Review

1C: Accounting is an intangible asset, a software platform for the comprehensive and rapid automation of all business processes for enterprises interested in acquiring and purchasing specialized professional software, including the 1C: Accounting program, developed entirely using various programming languages and specialized software, including 1C: Enterprise, with usage rights acquired through import.

Săcărin, Bunea and Guinea (2021, Vol. II) confirms that an entity's operating cycle must always be considered in conjunction with its primary and secondary business activities, representing the period of time between the acquisition of assets intended for processing and their final conversion into cash or cash equivalents. Depending on the nature of the business, the duration of the entity's operating cycle may exceed 12 months.

According to Tax Code No. 1163/1997, a business entity is any individual or legal person engaged in entrepreneurial activity (Parliament of the Republic of Moldova, 1997, Art. 5, paragraph (13)).

According to Lozan (2024), an operating system is a set of programs that manages the computer's physical resources and facilitates interaction between hardware and software components. It ensures the efficient distribution of resources to various programs and mediates communication between physical equipment and the software used by users (p. 8).

According to Lungu and Băra (2007), a data warehouse is a centralized repository of detailed data from all relevant sources within an organization, enabling dynamic querying and detailed analysis of all information.

Databases are also represented by the relational model. According to Lungu (2005), the relational model is defined by the data structure, the operators that act on the structure, and the integrity constraints. Capaţina and Moraru (2019) conducted a study on calculations using tabular data to generate reports based on financial, statistical, and accounting operations, which can subsequently be used to create charts and graphs.

According to Oprean and Țițu (2007), the revolution in production systems - brought about by the widespread introduction of microelectronics and information technology, the development of flexible manufacturing systems, and the use of cutting-edge technologies - has made it possible to produce increasingly complex products.

The rapid evolution of technology, particularly in the field of mobile devices, prompted the author Zamfiroiu (2016) to develop and describe a study on the creation of software metrics for evaluating the quality of mobile applications used in the educational environment.

The author Mazilescu (2009) studied the technologies required for building distributed applications, programming languages, the characteristics of the programming languages relevant to the study, and projects and solutions developed using the analysed technology. Năstase and Năstase (2002) explain technological evolution through the importance of information exchange and the advantages offered by computer networks.

According to Mazilescu (2016), an information system is a working system whose internal functions are limited to processing information based on six types of operations: acquisition, transmission, storage, retrieval, manipulation, and display of information. An information system produces information, assists, or coordinates the work performed by other work systems. A work system is a system in which participants (people and/or machines) carry out a process using information, technology, and other resources to produce products and/or provide services intended for internal or external customers.

According to Baldin and Utkin (2006), an automated management system is a system designed to automate all or most of the management tasks performed by a collective management body (shareholders, founders, the board of directors, etc.).

According to the Accounting and Financial Reporting Law No. 287/2017, asset recognition involves recording and presenting an accounting item that meets the recognition criteria established in accounting standards (Parliament of the Republic of Moldova, 2017, Art. 3).

The definition of intangible assets is found in the works of various authors through common approaches; for example, Grigoriu et al. (2021) proposed a definition stating that intangible assets are non-monetary assets that do not have a physical form, are identifiable, and are controllable by the entity.

The National Accounting Standard „Intangible and Tangible Assets” regulates the recognition and measurement of intangible assets, including computer software (Ministry of Finance of the Republic of Moldova, 2013).

Săcărin, Bunea and Guinea (2021, Vol. I), define intangible assets as non-monetary items, as they generate economic benefits for the entity through their use rather than through the receipt of cash at maturity, as is the case with receivables, for example.

According to the Methodological Guidelines on Accounting for Individuals Engaged in Entrepreneurial Activities, intangible assets are non-monetary assets that do not have a physical form and have a limited useful life (e.g., concessions, licenses, and trademarks; copyrights and protection titles; computer programs and other intangible assets (websites, recipes, formulas, models, designs, etc.)) (Ministry of Finance of the Republic of Moldova, 2022, Art. 31).

The accounting principles pertaining to computer programs, including specialized software such as 1C: Accounting, are developed and set forth in the entity's Accounting Policies. According

to the National Accounting Standard „Accounting Policies, Changes in Accounting Estimates, Errors, and Subsequent Events”, accounting policies are selected by each entity independently and approved for each reporting period by the person responsible for accounting and financial reporting (Ministry of Finance of the Republic of Moldova, 2013, Art. 5).

According to the National Accounting Standard „Intangible and Tangible Assets”, the initial recognition of intangible assets is carried out as set forth in paragraph 6 of the standard, subject to the following specific rules: intangible assets held in or on a physical object, such as data carriers (in the case of software) or legal documentation (in the case of a license), are recognized on the date of acquisition of the right to use such information (Ministry of Finance of the Republic of Moldova, 2013, Art. 39).

Pursuant to the National Accounting Standard „Presentation of Financial Statements”, in the Balance Sheet, one of the forms of the Financial Statements, line 020 „Intangible Assets in Use” reflects the carrying amount of intangible assets put into use, determined in accordance with the National Accounting Standard „Intangible and Tangible Assets.” Lines 021–024 of the Balance Sheet present the carrying amount of the classes of intangible assets: concessions, licenses, and trademarks; copyrights and protection titles; software and other intangible assets (Ministry of Finance of the Republic of Moldova, 2013, Art. 32).

Artificial intelligence, according to Andone and Tugui (1999), is a field that is increasingly attracting the attention of economists, managers, and other professionals, as knowledge-based expert systems, genetic algorithm-based systems, fuzzy systems, hybrid systems, and neural networks are artificial intelligence systems poised to play an increasingly important role in their professional lives.

Nuno (2022) considers that, in fact, some authors present intelligence as a blend of concepts drawn from classical scientific disciplines, such as philosophy, mathematics, economics, neuroscience, psychology, computer science, control theory, cybernetics, and linguistics. With the widespread use of artificial intelligence, legal entities and individuals - including those who use specialized software - must not overlook information security.

Information security is a process aimed at ensuring the protection of information from unauthorized actions, such as unauthorized access, use, disclosure, interruption, modification, or destruction of information. Zgureanu (2018), argues that security assurance techniques can be applied to any information, regardless of its nature, and it is important to note that information has value, particularly when it is the subject of exchange or processing - that is, precisely when it is vulnerable to parties that cannot be considered trustworthy.

All of the points presented by the author, based on an analysis of the scientific literature - which formed the authoritative foundation of the research - enable us to establish, through research, the need to examine the basic principles governing the operation of the Accounting module of the specialized software 1C: Accounting, principles that were selected for study by the author, as it was established through an examination of the working procedures employed by specialists trained in accounting and finance that research in this field is current and subject to further examination by the author.

Methodology

The research method is based on the analysis of theoretical and practical materials on problematic aspects of using the 1C: Accounting system, intended for users of this software

responsible for working with the system, including accounting specialists. The theoretical framework is based on analysis, synthesis, deduction, and the inductive method, used to achieve the clearest and most representative interpretation.

The importance of the research presented in this article lies in achieving the aforementioned goal and objective by examining the fundamental operating principles of the Accounting component of the 1C:Enterprise system, as well as the works, research, and opinions of authors of specialized literature, scientists, and researchers, with the goal of improving the accounting and use of the 1C:Accounting system.

Results and Discussion

Assets play a significant role in the statement of financial position. A mandatory requirement of the provisions of the National Accounting Standards „Presentation of Financial Statements” is the classification of assets in the statement of financial position - such as the balance sheet - into non-current assets and current assets (Ministry of Finance of the Republic of Moldova, 2013, Art. 22). According to Turcanu and Golocialova (2015), fixed assets include intangible assets, tangible assets, and financial assets.

Over the past 20 years, in developed economies, the demands of the active market for goods and services have led to fiercer competition among business entities. Under these conditions, the drive toward achieving the desired commercial results has prompted significant investments in marketing and in areas that could support the entity’s competitive capacity. As a result, a diversified system of indicators expressing competitive capacity was created, which, from an economic standpoint, represents intangible assets: the trademark (trademark logo and registered name); goodwill (business goodwill), identified through investment in funds, new technologies, and technological solutions.

According to Grigoroi et al. (2021), computer software consists of a set of technical and operational documentation, as well as programs for information processing systems. Computer software that controls the operation of technological equipment or other machinery are recorded in accounting as an element of this group of intangible assets if they are identifiable, i.e., accounted for separately from the computer and equipment whose operation they control (they are not an integral part of them), and if their value can be determined separately (as in the case of the specialized software 1C. Accounting, which is purchased and identified separately from the technical equipment). Otherwise, such computer programs are included as part of the respective fixed assets (a component part of the computer or machinery).

Information systems have become absolutely essential in today’s society, providing users with access to a wide variety of applications and, by extension, information, while also serving as a fast-paced communication medium. For example:

- remote access to programs, through which the user has the latest version of the product at their disposal, including specialized software such as 1C: Accounting, and the ability for the accountant to enter information from supporting documents regarding the economic transactions carried out by the enterprise;
- remote access to databases for performing economic operations related to the remote purchase and sale of goods and services (purchase invoices, sales invoices, etc.),

banking operations, calculation and payment of employee salaries, and other fees calculated and paid to the entity's administration, etc.

When the topic of automation comes up, individuals and businesses interested in cutting-edge technologies needed to carry out core operational activities often envision complex IT systems and expensive software. But in reality, automation is primarily about process optimization: eliminating manual routines, implementing standardized procedures, and delegating tasks to a professional team.

Outsourcing accounting is one of the simplest and most effective ways to automate bookkeeping without implementing software. Thanks to a well-coordinated team, organized internal processes, and a systematic approach, the business achieves results quickly, without extra effort. However, currently, a large percentage of users of professional software such as companies in the real sector and government agencies - are automating financial operations by using specialized software, purchased as needed from domestic or foreign companies that develop and sell these programs as finished products in the form of modern data storage and processing technologies, including those for the financial sectors of organizations.

Building on the procedures outlined by Garofil (2023), we assume that a company purchased a software program during the implementation phase and requested additional developments, for which a supplementary agreement was signed.

Let us assume that the services for the creation, implementation, and installation of a specialized software program, for example, 1C: Accounting, are provided within the territory of the Republic of Moldova by a resident legal entity over a period of 6 months, and their value amounts to 62,400.00 lei, including 20% VAT – 10,400.00 lei.

According to the Purchase/Sale Agreement concluded between the buyer company and the supplier entity, the supplier's tax invoices must be paid on the date the specialized software program 1C: Accounting is put into operation.

In addition to the cost of purchasing the software, the buyer incurred costs totalling 9,720.00 lei, including 20% VAT - 1,620.00 lei, related to the professional services provided by a law firm to finalize the contract for this transaction.

To confirm the economic transaction involving the creation, implementation, and installation of the software, the following documents must be prepared.

Service Agreement: Pursuant to the provisions of the Civil Code No. 1107/2002, under a Service Agreement, one party (the service provider) undertakes to provide certain services to the other party (the beneficiary), and the latter undertakes to pay the agreed contractual amount. The subject matter of the service contract consists of services of any nature (Parliament of the Republic of Moldova, 2002, Art. 1013).

Pursuant to the Accounting and Financial Reporting Law No. 287/2017 (AFRL, 287/2017), the entity shall use standardized forms for primary documents, as approved by the Ministry of Finance and other public authorities. In the absence of standardized forms or if they do not meet the entity's needs, the entity shall develop and use document forms approved by its management in compliance with the requirements of AFRL, 287/2017 (Parliament of the Republic of Moldova, 2017, Art. 11(4)).

Primary documents prepared both on paper and in electronic form have the same legal force. If the primary document is prepared in electronic form, the entity is required to provide the user with a paper copy of the document upon request.

According to the Accounting and Financial Reporting Law No. 287/2017, primary documents must contain the following mandatory elements:

- a) the name and number of the document;
- b) the date the document was prepared;
- c) the name, address, and IDNO (tax identification number) of the entity on whose behalf the document is drawn up;
- d) the name, address, and IDNO (tax identification number) of the document's recipient, and for individuals - the IDNP (personal identification number);
- e) the content of the economic transactions;
- f) the quantitative and monetary units in which the economic transactions are expressed;
- g) the positions, surnames, first names, and signatures of the persons responsible for carrying out (performing) the economic transactions (Parliament of the Republic of Moldova, 2017, Art. 11(7)).

Since there is no standard form for a service acceptance report, the company must prepare one on its own, ensuring that it includes the following mandatory elements:

- Minutes of Commissioning of Intangible Assets: On the date of commissioning of intangible assets, the company must prepare Minutes indicating the date of commissioning of the intangible assets, their acquisition cost, and their useful life, based on which depreciation will be calculated in accordance with one of the methods provided for in the National Accounting Standard „Intangible and Tangible Assets” (Ministry of Finance of the Republic of Moldova, 2013, Art. 4).
- Documents evidencing payment for services: The document confirming payment for services via bank transfer is the payment order, and for cash payments, the cashier's receipt.

Based on the economic transactions described, the following accounting entries are recorded (see Table 1).

Technology is a key partner for the accounting profession, designed to assist in recording the economic transactions characteristic of an organization's core activities as documented in strategically addressing issues related to data recording, storage, and analysis, as well as in risk management.

This article describes the basic principles of operation of the „Accounting” component of the 1C: Enterprise system and discusses methods for working with the system. Configuration issues are not addressed here.

Table 1. Accounting entries for recording the creation, implementation, and installation of the 1C: Accounting software

(in MDL)

No.	The nature of the economic transaction	Total value	Corresponding accounts		Supporting documents
			Debit	Credit	
1	2	3	4	5	6
1.	Costs associated with the design, implementation, and installation of the purchased software, up to the date of commissioning (62,400.00 lei - 10,400.00 lei (VAT) = 52,000.00 lei)	52000,00	111 Intangible assets in progress	5211 Commercial debts in the country	Financial invoice, Register of Procurements, Service handover report, Ledger for accounts 111 and 5211.
2.	VAT deduction relating to the value of the intangible asset 1C: Accounting purchased (52,000.00 lei * 20% / 100% = 10,400.00 lei)	10400,00	5344 Value-added tax liabilities	5211 Commercial debts in the country	Financial invoice, Register of Procurements, Service handover report, Ledger for accounts 5211 and 5344.
3.	Payment for services provided by the supplier (52000,00 lei + 10400,00 lei (VAT) = 62400,00 lei)	62400,00	5211 Commercial debts in the country	241 Cash flow, 242 Current accounts in local currency, 243 Foreign currency current accounts	Payment order or cashier's order, Account statement or Cash register, Ledger for accounts 241, 242, 243 and 5211.
4.	Confirmation of receipt of professional services for the finalisation of the contract for the purchase and sale of the 1C: Accounting software by a law firm (9720,00 lei - 1620,00 lei (TVA) = 8100,00 lei)	8100,00	111 Intangible assets in progress	5443 Other estimated current liabilities	Financial invoice, Register of Procurements, Service handover report, Ledger for accounts 111 and 5443.
5.	Eligibility for VAT deduction on professional services received from a law firm (8100,00 lei * 20% / 100% = 1620,00 lei)	1620,00	5344 Value-added tax liabilities	5443 Other estimated current liabilities	Financial invoice, Register of Procurements, Service handover report, Ledger for accounts 5344 and 5443.
6.	Payment for services provided by the law firm (8100,00 lei + 1620,00 lei (TVA) = 9720,00 lei)	9720,00	5443 Other estimated current liabilities	241 Cash flow, 242 Current accounts in local currency, 243 Foreign currency current accounts	Payment order or cashier's order, Account statement or Cash register, Ledger for accounts 241, 242, 243 and 5443.
7.	Implementation of the 1C: Accounting software (rd.1 + rd. 4), (52000,00 lei + 8100,00 lei = 60100,00 lei)	60100,00	1123 Software programs	111 Intangible assets in progress	Protocol for the Commissioning of Intangible Assets, Accounting Note, Ledger for accounts 111 and 1123.

Source: Developed by the author

According to Baldin (2012), Configuration management is one of the supporting processes that underpin the core processes of the software lifecycle, primarily software development and maintenance. When creating projects for complex information systems consisting of many components, each of which may have variants or versions, the problem arises of tracking their relationships and functions, creating a unified structure, and ensuring the development of the entire system. Configuration management allows for the organization, systematic tracking, and control of changes made to software at all stages of the lifecycle .

The 1C: Accounting system can be used to manage any aspect of accounting at enterprises of various types that may engage in different types of business activities.

1C: Enterprise can support different accounting systems and maintain records for multiple enterprises within a single database.

The diverse and flexible capabilities of the 1C: Enterprise system allow it to be used both as a fairly simple and intuitive tool for accountants and as a means of fully automating accounting processes, from entering source documents to generating financial statements.

The 1C: Accounting system can be used to manage virtually any area of accounting:

- bank and cash transactions;
- fixed assets and intangible assets;
- materials and inventory;
- goods, services, and production;
- foreign currency transactions;
- settlements with organizations, debtors, creditors, and accountable persons;
- payroll accounting;
- budget settlements;
- other accounting areas.

The 1C: Accounting system offers flexible accounting capabilities:

- synthetic accounting based on a multi-level chart of accounts;
- accounting using multiple charts of accounts;
- foreign currency accounting and currency hedging;
- multidimensional analytical accounting;
- multi-level analytical accounting for each dimension;
- quantitative accounting;
- accounting for multiple enterprises within a single database.

Data entry in 1C: Enterprise can be organized with varying degrees of automation:

- manual transaction entry mode,
- standard transaction mode;
- automatic transaction generation based on documents.

An important distinction between accounting accounts and other data types is the ability to create accounts both in the configuration and within the database itself. Including specific accounts in the configuration is used when the configuration itself is created using these accounts and their specific properties, for example, if the configuration specifies the automatic generation of journal entries for these accounts.

Brief description of system concepts. The information provided below is a brief description of the concepts of the 1C: Enterprise system that the user works with during system operation. Among those listed below, we can distinguish the basic (general) concepts of the 1C: Enterprise system, as well as concepts that relate exclusively to the „Accounting” component.

Basic Concepts of 1C: Enterprise.

Constants. As a rule, constants are used to work with fixed and semi-fixed information, but they can also represent data that changes periodically. These are mainly the most general details about the organization being accounted for: „Company Name,” „VAT Rate,” „Chief Accountant’s Full Name,” etc.

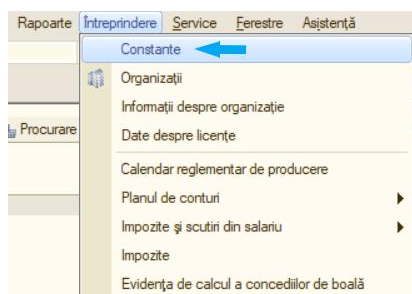


Figure 1. Setting Constants using the Program's Information blocks

Source: Developed by the author

Reference Lists. These are designed to store information about a large number of similar objects, which are used for maintaining analytical records and filling out documents. Typically, reference lists include inventories of fixed assets, materials, organizations, currencies, goods, employees, and others.

1C: Enterprise supports working with multi-level reference books and subordinate reference books.

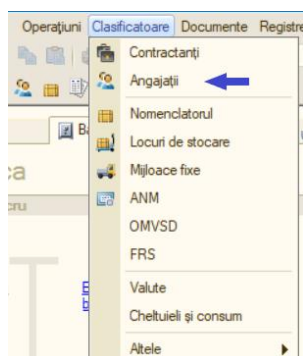


Figure 2. Types of Classifiers for Categorizing information

Source: Developed by the author using the specialized software 1C: Accounting

Enumerations. Enumerations are used in the system to define sets of fixed (non-user-modifiable) values. Typical examples of enumerations include payment methods (cash, non-cash, barter), founder type (legal entity, individual), employee types (full-time, part-time), and so on.

Documents. Documents can be used to record any events occurring at the enterprise, as well as to manage settlements and data in 1C: Enterprise. As a rule, the set of documents in 1C: Enterprise corresponds to the set of actual source documents used in the organization that need to be entered into the database: payment orders, invoices, receipts and delivery notes, cash orders, etc.

Each document has a visual representation (screen form) and may contain an unlimited number of fields in the header and body, which are filled in when the document is created (entered into the system). In addition, a document typically has a print form, which serves as its „paper” equivalent.

An important feature of a document is its ability to automatically generate an accounting transaction. Such a transaction will be associated with the document. Manually entered transactions are, in fact, also a special type of document, which is called an „Operation.”

Journals. 1C: Enterprise provides journals for viewing documents. The document journal allows you to view a list of documents sorted by document type or all documents at once.

Reports and processing. Reports are used to obtain various types of information, including summaries or detailed data selected based on specific criteria. Reports are used both to analyze accounting totals and cash flow (trial balance, journal-order, etc.) and to generate data for tax authorities and other agencies (balance sheet, tax returns, and other reports). Processes are used to perform various service or routine tasks, such as price indexing in product catalogs.

Concepts of the „Accounting” component.

Accounting accounts. Accounting accounts (hereinafter “Accounts”) are designed to store charts of accounts, i.e., objects of synthetic accounting for an enterprise's funds. The essence of these objects fully corresponds to the generally accepted understanding of accounting accounts. The properties of accounting accounts can be flexibly configured depending on the accounting system adopted in a specific country and for a specific type of enterprise.

1C: Enterprise can support multiple charts of accounts simultaneously. For each chart of accounts, you can define a custom account code length and the number of subaccount levels, as well as the number of digits in the subaccount for each level.

Transactions and journal entries. Movements of funds are recorded in accounting as transactions and journal entries. A transaction is a complete representation of a business transaction that occurred at an enterprise, as reflected in the accounting records. It may contain several journal entries. Journal entries do not exist independently of transactions.

Each journal entry belongs to one and only one transaction. For example, a transaction involving the receipt of an advance payment will contain two journal entries: the crediting of funds to the checking account and the accrual of VAT on the advance payment received.

Subaccount. The term „subaccount” is used to denote a set of values used for maintaining analytical records for accounting accounts. Subaccounts are typically objects for which analytical accounting is maintained at the enterprise: fixed assets, organizations, goods, etc.

The subaccount type defines the set of objects of a specific type that are used for analytical accounting. Each subaccount type has one of the data types available in the system, which determines the set of values for subaccounts of that type - usually a reference table or a list.

For example, the „Fixed Assets” subaccount type will have the type „Fixed Assets” lookup table. At the same time, two subaccount types can have the same lookup table type: for example, the „Inventory” and „Fixed Assets” subaccount types can refer to the same „Tangible Assets” lookup table.

Existing subaccount types are used to configure analytical accounting for general ledger accounts. When entering journal entries for accounts subject to analytical accounting, subaccount values are entered according to their types.

Standard Transactions. The standard transaction mechanism allows users to automate the entry of frequently recurring transactions. To do this, the user creates a standard transaction template, in which they define a „scenario” for the transactions. When entering a transaction using a standard transaction, the data is automatically populated based on the standard transaction template. If necessary, missing transaction values (analytical objects, currency, quantity, and others) are requested, and transaction amounts are calculated using the formulas defined in the template.

Valid Transactions. The valid transaction mechanism is designed to automatically validate entered transactions. The user populates the list of valid transactions according to their understanding of proper accounting practices. Then, during transaction entry, if the corresponding parameter is enabled, the system validates the transaction entries using the list of valid transactions.

Transaction and Operation Logs. The transaction log is used to view a list of all accounting transactions. In this log, each transaction is displayed on a single line containing the most important information (date, number, description, amount). The transaction log allows you to view existing transaction entries in a consolidated list.

Principles of Operation of the 1C: Enterprise System.

The operation of the 1C: Enterprise system is divided into two distinct processes: setup (configuration) and the user’s direct work involving record-keeping or performing calculations. Thus, all work with the system can be divided into two stages, which can be alternated at will:

- configuration;
- direct user work with the database.

In addition to the aforementioned startup modes of 1C: Enterprise, there is a „Debugger” startup mode designed for debugging data processing algorithms created in configuration mode.

Configuration. During the configuration stage of the 1C: Enterprise system, various system modes are set up in accordance with the specific characteristics of a particular enterprise. This involves defining the structures and properties of reference books and documents, describing report forms and generation algorithms, developing calculation types, and configuring synthetic, analytical, quantitative, and currency accounting.

When configuring the system, the configuration developer or system administrator can also create sets of data access rights corresponding to users at different levels. The number and structure of these sets of rights are determined by the specific system configuration.

To ensure that the interface of a specific system configuration fully reflects the configured data structures, the system's Configurator provides the ability to customize common interface components: menus, toolbars, and keyboard shortcuts.

In addition, during the configuration phase, multiple user interfaces can be created for different types of users (managers, accountants, HR specialists, etc.), and a user list is created for a specific organization.

User Operations. The user interacts with the database when the system is launched in „1C: Enterprise” mode. This involves the actual operation of the system within the subject area: entering documents and transactions, populating reference books, generating various reports, performing various regulatory calculations, etc.

The user is provided with the ability to enter and process information described in the configuration structure using algorithms created during the configuration phase.

This article provides a general description of the user workflow when working with the 1C: Enterprise system in various modes: maintaining reference books, entering documents and transactions, performing calculations, generating reports, and more. It also specifies which system properties may change and how, depending on the configuration being used.

Explanations of the specifics of working with specific modes (documents, operations, reference books, reports) that depend on the configuration may be included in the configuration description itself. Let's list the main features of the 1C: Enterprise system's behavior that are determined by a specific configuration:

- set of constants;
- composition, structure, and properties of reference books;
- forms for viewing reference list views and entering reference list items;
- the composition and set of values for enumerations;
- forms for entering documents and transactions;
- forms for document, transaction, and posting journals;
- the set of charts of accounts and their properties;
- forms for account lists and account entry;
- accounting accounts (only those specified in the configuration);
- forms and algorithms for reports and processing;
- user interface (main menu, set of toolbars);
- user rights for accessing various program objects and modes.

Constants. Constants in the 1C: Enterprise system are generally used to store information that either never changes during the system's operation or changes only very rarely. The simplest example of such information is the organization's name, which typically remains unchanged.

The convenience of using constants lies in the fact that information is entered into them once and can then be reused multiple times when generating documents, in calculations, and when building report forms. For example, the aforementioned organization name can be entered into a specially defined constant, and the constant name can be used in numerous forms to retrieve its value - the organization name. If there are any changes to the organization name, it is sufficient to change it just once, in the constant, and all changes will be automatically reflected in the places where this constant is used. During the task configuration process, you can create a virtually unlimited number of constants to store any necessary information.

Constants List Window. All operations involving constants are performed in the dedicated „Constants List” window. If the end user has access to constants, this window can be opened via a menu item, a toolbar button, or the “Operations” system menu. Unless otherwise specified in the configuration, the constant list can be displayed by selecting the „Constants” item in the „Operations” menu of the program's main menu.

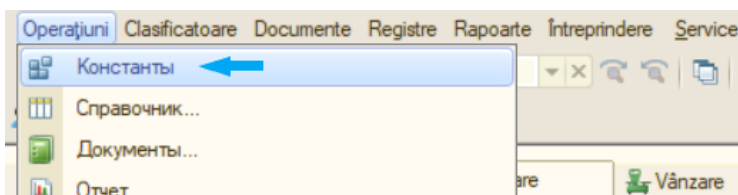


Figure 3. Constants opened via the Operations information block

Source: Developed by the author

The constant list window is a table consisting of three columns. The „Code” column displays the abbreviated names of the constants. The full name is used to explain the abbreviated name of the constant. Finally, the „Value” column contains the constant's value. The order of constants in the list is specified in the 1C:Enterprise System Configurator. One cell in the window is always highlighted in a contrasting color and is called the „active” or „current” cell. The term „cursor” is also used to refer to this selection.

The constant list window may contain a toolbar for quick access to frequently used list operations. The position of the toolbar in the window (top, bottom, right, or left) can be set in the interface settings (the „Parameters” item in the „Tools” menu of the program's main menu). There, you can also disable the toolbar in the constant list window entirely. Unless otherwise specified in the interface settings, the toolbar is usually located at the top of the constant list window, below the window title bar. To view the list of constants, use the standard methods for working with the table section of the form.

Editing constants. When using 1C: Enterprise, you can only modify the values of constants in the list during a user session. Adding new constants, deleting unnecessary constants, and changing the short or full name of existing constants can only be done in the Configurator.

To change a constant’s value, place the cursor in the table cell containing the value to be changed and press the Enter or Shift+Enter key. The cell will switch to edit mode, and a text cursor in the form of a blinking vertical line will appear in it.

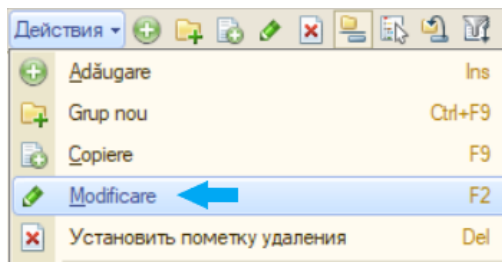


Figure 4. The Edit Function – operating methods

Source: Developed by the author

When creating a constant during the configuration phase, in addition to the code and full name, you must specify the type of its value. Depending on the constant's value type, its value will be entered in different ways. After making the necessary changes, press the Enter key to exit edit mode.

Working with the history of a constant's value. When configuring a task, you can specify for any constant whether to store the history of its value changes. Such constants are called periodic constants. In this case, the list of constants will store not only the most recent value of the constant, but also all previously existing values along with their entry dates. This mechanism allows you to retrieve the value of such a constant that existed on any given date.

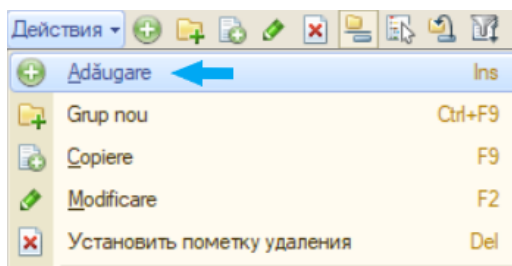
To view the history of a constant's values, place the cursor on the row containing the desired constant and perform one of the following actions: press the F5 key, click the History button on the reference window's toolbar, or select "Value History" from the "Actions" menu in the program's main menu.

The constant value history window is a table consisting of two columns: date and the constant value on that date. The entries in the table are sorted by date. To view the constant history, use the standard methods for working with the table section of the form.

You can modify the constant value history in two ways: by entering a new constant value in the list of constants, or by entering and editing rows in the constant value history window. These methods differ in how they work, so let's examine them separately.

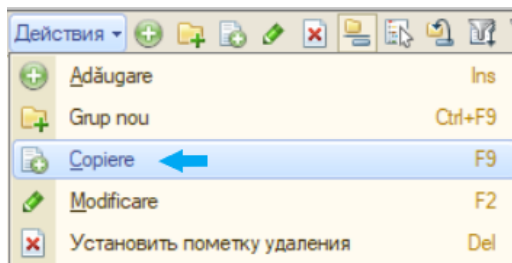
When you edit a constant value, a new row is automatically added to the history, containing the constant value and the date it was entered. However, if the constant value was changed multiple times on the same date, no new rows are added to the history; only the last value entered is saved.

On the other hand, if an existing value was re-entered for the constant but with a different date, a new row will be added to the constant value history. The constant value history can be edited in the „History” window. To enter a new row, do one of the following: click the Enter button on the history window toolbar, or press the Ins key, or open the „Actions” menu in the program's main menu and select „New Row” from that menu.

**Figure 5. Add Function – operating methods**

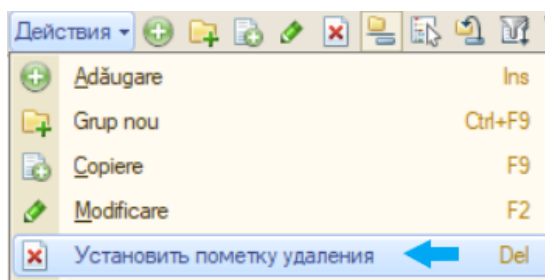
Source: Developed by the author

A new row will be added to the table; enter the date and the constant value for that date in the corresponding fields. To cancel adding a new row to the history, press Esc. You can add a new row by copying an existing one. To do this, place the cursor on the row you want to use as a template and do one of the following: press the F9 key, click the Copy button on the history window toolbar, or select „Copy Row” from the “Actions” menu in the program's main menu.

**Figure 6. Copy Function – operating methods**

Source: Developed by the author

A new row will be inserted into the table, with its columns filled with data taken from the sample row. After making the necessary corrections, press the Enter key. To delete a row from the history, place the cursor on the history row you want to delete and do one of the following: press the Del key, click the Delete button on the history window toolbar, or select „Delete Row” from the „Actions” menu in the program's main menu. After answering „Yes” to the prompt asking to delete the entry, the line will be deleted.

**Figure 7. The Select Items for Deletion Function – operating methods**

Source: Developed by the author

Quick Search in the Constant History. In addition to the standard free-text search mode, the constant history offers a quick search option. To quickly navigate to the desired entry in the constant history, you can use the quick search by date feature. To perform a quick search, use the keyboard or mouse to place the cursor in the „Date” column and simply type the

desired value. You should enter the year first, then the month without a period, and finally the day: for example, „260326” (March 26, 2026).

The search proceeds downward from the current cursor position in the list of constants. When the first character you entered is found, it appears in the box at the bottom of the column, and the cursor moves to the cell in the list of constants whose first characters match the ones you entered. You can delete the last character you entered from the search string by pressing the Backspace key.

Conclusions

The 1C Accounting system can be used to manage any accounting section at various types of enterprises. This article examines and describes the basic operating principles of the Accounting component of the 1C Accounting system, as well as provides examples of how to use the system.

This information provides a brief description of the 1C Accounting system concepts that users will encounter during operation, being the study, which is exposed in this article to initiate the development of the subject, related to the analysis of constants, nomenclatures and other information blocks of the described computer system, through the prism of accounting records for the procurement of the computer program and the initiation of work with the specialized software, installed at the entity to facilitate the recording of the large workload of the financial sector by automating work processes.

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REGENERATION OF TEACHING HUMAN CAPITAL: A STRATEGIC APPROACH TO THE SUSTAINABILITY OF THE EDUCATIONAL SYSTEM

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Abstract: *In knowledge-based economies, education systems play a fundamental role in human capital formation and in supporting long-term economic development. In this context, the stability and quality of the teaching workforce become strategic factors for the sustainability of educational systems. This paper analyzes the issue of teaching human capital regeneration from the perspective of the economics of education and public sector human resource management. The study highlights the economic and institutional costs generated by the instability of the teaching workforce, as well as their impact on the efficiency of public investment in education. The analysis focuses on the Romanian educational system, identifying several structural challenges, including demographic decline, fragmented teaching workloads, the uneven distribution of teaching positions between urban and rural areas, and recruitment difficulties in specific segments of the system. Based on this analysis, the paper proposes a strategic model for managing teaching human capital, structured around three complementary dimensions: attraction, stabilization, and professional regeneration. The model emphasizes the need for integrated public policies aimed at strengthening the stability of the teaching workforce and enhancing the sustainability of the educational system. The findings suggest that the regeneration of teaching human capital should be understood as a strategic investment with long-term economic, social, and institutional implications.*

Keywords: *teaching human capital; educational sustainability; human resource management in education; teacher retention; educational public policies; economic development*

Classification JEL: *I25, J24, H52*

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1. Introduction

In knowledge-based economies, human capital is widely recognized as a fundamental factor of economic growth, innovation, and social development. Education systems play a central role in the formation of human capital by providing individuals with the knowledge, skills,

and competencies required to participate effectively in modern labor markets. As a result, the quality and sustainability of education systems have become increasingly important not only for educational outcomes but also for the long-term competitiveness and resilience of national economies (OECD, 2023; World Bank, 2023).

Within this context, teachers represent one of the most valuable resources of any educational system. Their professional expertise, commitment, and continuous development directly influence the quality of teaching and learning processes, as well as the formation of future generations of human capital. However, educational systems across the world are facing growing challenges related to teacher shortages, workforce ageing, declining attractiveness of the teaching profession, and difficulties in recruiting and retaining qualified personnel (European Commission, 2023; UNESCO, 2024). These developments have increased concerns regarding the long-term capacity of education systems to maintain a stable and effective teaching workforce.

The instability of teaching human capital has implications that extend beyond the institutional level of schools. High levels of teacher turnover can affect the continuity of the educational process, reduce the efficiency of public investment in education, and contribute to educational inequalities, particularly in disadvantaged communities (OECD, 2024). From this perspective, the management of teaching human capital has become a strategic issue closely linked to educational sustainability and broader socio-economic development.

The Romanian educational system reflects many of these international trends while also facing specific structural challenges. Demographic decline, migration, territorial disparities between urban and rural areas, and difficulties in staffing certain educational segments place additional pressure on the management of educational human resources. In some areas, such as education in minority languages, recruitment and retention challenges are further intensified by the limited availability of qualified teachers with the required linguistic and professional competencies.

Against this background, the regeneration of teaching human capital emerges as an essential condition for ensuring the sustainability of the educational system. Regeneration should not be understood solely as the replacement of retiring teachers, but as a broader process that includes attracting new entrants to the profession, supporting their professional integration, and creating opportunities for continuous development throughout their careers.

This paper addresses the challenges associated with the regeneration of teaching human capital in the context of demographic change, teacher shortages, and workforce instability. Its purpose is to examine the strategic role of teaching human capital in supporting educational sustainability and to propose a conceptual framework for its management and regeneration. The study combines perspectives from the economics of education and public sector human resource management to analyze the main vulnerabilities affecting the Romanian educational system and to develop a strategic model based on three interconnected dimensions: attraction, stabilization, and professional regeneration. By doing so, the paper contributes to the ongoing discussion on educational sustainability and highlights the importance of long-term policies aimed at strengthening the stability, quality, and resilience of the teaching workforce.

The remainder of the paper is organized as follows. The next section reviews the relevant literature on teaching human capital and teacher retention, followed by the presentation of the research methodology. The results and discussion section examines the Romanian

educational context and introduces the proposed strategic model. The paper concludes with policy implications, limitations, and directions for future research.

2. Literature Review

2.1. Teaching Human Capital and Teacher Retention in Educational Systems

The role of teachers in the development of human capital has been widely recognized in the literature on the economics of education and public policy. As the primary agents responsible for knowledge transmission and skills development, teachers significantly influence educational outcomes, labour market preparedness, and long-term economic growth (OECD, 2023). Consequently, the quality, availability, and stability of the teaching workforce have become central concerns for educational systems worldwide.

Recent studies indicate that many countries are facing increasing difficulties in attracting and retaining qualified teachers. International organizations have reported persistent teacher shortages, ageing teaching populations, and declining interest in teaching careers among younger generations (European Commission, 2023; UNESCO, 2024). These trends have raised concerns regarding the long-term sustainability of educational systems and their capacity to provide equitable access to quality education.

In response to these challenges, the concept of teacher retention has received growing attention in both research and educational policy. Earlier approaches primarily focused on teacher preparation and initial qualification, whereas more recent studies emphasize the importance of supporting teachers throughout their professional careers. Retention is increasingly understood as the result of a complex interaction between financial incentives, working conditions, professional recognition, career development opportunities, and institutional support mechanisms (World Bank, 2023).

However, despite the growing volume of research on teacher retention, the literature remains fragmented. Many studies examine individual determinants of teachers' decisions to remain in or leave the profession, but fewer studies address the broader dynamics of teaching human capital across the entire professional lifecycle. Recruitment, retention, and professional development are frequently analysed as separate policy domains, even though they are closely interconnected in practice. As a result, existing research often provides partial explanations of workforce sustainability without offering an integrated perspective on how educational systems can continuously regenerate their teaching human capital.

This limitation is particularly relevant in the context of contemporary demographic and social transformations. Educational systems are not only required to retain existing teachers but also to attract new entrants and support their long-term professional development. Consequently, there is a growing need for conceptual approaches that view teaching human capital as a dynamic resource requiring continuous regeneration rather than merely periodic replacement.

2.2. The Economic Implications of Teaching Workforce Instability

The increasing attention given to teacher retention is closely linked to the economic and institutional consequences of workforce instability. In the economics of education, teacher turnover is no longer viewed solely as a human resource issue but as a factor that directly affects the efficiency of public investment in education and the performance of educational systems.

Workforce instability generates several categories of costs. Direct costs arise from recruitment, selection, induction, and training activities required to replace departing teachers. Educational institutions invest significant resources in developing professional competencies, and these investments become less efficient when teachers leave the profession after relatively short periods of service. In addition, educational systems must repeatedly allocate resources to attract and prepare new entrants.

Beyond these direct costs, teacher turnover also creates organizational challenges. Frequent staff changes may disrupt the continuity of educational processes, increase administrative burdens, and weaken schools' capacity to implement long-term development strategies. International evidence suggests that teacher shortages have become a structural concern rather than an isolated phenomenon. OECD reports indicate that the proportion of students enrolled in schools affected by teacher shortages has increased significantly in recent years, highlighting the growing scale of this challenge (OECD, 2024).

The literature also emphasizes the broader social consequences of workforce instability. High levels of teacher turnover may negatively affect student achievement, reduce educational quality, and contribute to inequalities between schools and regions. These effects are particularly visible in disadvantaged communities, where difficulties in attracting and retaining qualified teachers may reinforce existing educational disparities (OECD, 2024).

Although these economic and social consequences are increasingly recognized, important gaps remain in the literature. Existing studies tend to focus primarily on measuring direct financial costs or analysing retention at the institutional level. Comparatively less attention has been paid to the long-term implications of workforce instability for the regeneration of educational human capital and for the sustainability of educational systems as a whole. Furthermore, most international analyses focus on general trends, while the specific interaction between demographic change, territorial disparities, and human resource management receives less attention.

These limitations are particularly relevant for countries experiencing significant demographic transformations, such as Romania. Declining student populations, migration, regional inequalities, and challenges related to staffing specialized educational segments create conditions that differ from those examined in many international studies. Consequently, there is a need for context-specific analyses capable of connecting international evidence with the structural realities of national educational systems.

The review of the literature suggests that teacher shortages, retention difficulties, and workforce instability are increasingly recognized as major challenges for educational systems worldwide. Nevertheless, limited attention has been given to the integration of these issues within a comprehensive framework focused on the regeneration of teaching human capital. The existing literature provides valuable insights into recruitment, retention, and professional development, but these dimensions are often examined independently. This study seeks to address this gap by analysing the Romanian educational context and proposing a strategic model that integrates attraction, stabilization, and professional regeneration into a unified framework for the sustainable management of teaching human capital.

3. Methodology

This study employs a qualitative and descriptive research design aimed at analysing the challenges associated with the regeneration of teaching human capital and their implications for the sustainability of educational systems. The research combines perspectives from the economics of education and public sector human resource management in order to examine the factors influencing the stability and development of the teaching workforce.

The study is based primarily on documentary analysis and comparative analysis of secondary data. Documentary analysis was used to review relevant literature, policy documents, and reports published by major international organizations, including the Organisation for Economic Co-operation and Development (OECD), UNESCO, the World Bank, the European Commission, and Eurostat. These sources provided the theoretical and policy framework for understanding teacher shortages, workforce instability, and human capital management in education.

In addition, the study uses statistical data obtained from the Romanian National Institute of Statistics and the Romanian Ministry of Education. The analysis focuses on a set of indicators considered relevant for educational human resource management, including the evolution of the school-age population, the number of teachers, the student–teacher ratio, the territorial distribution of teaching staff between urban and rural areas, and trends related to teacher shortages reported at the international level.

The research follows a two-stage analytical approach. The first stage consists of a review of the literature and institutional reports in order to identify the main concepts and challenges associated with teaching human capital. The second stage involves the analysis and interpretation of selected educational indicators in the Romanian context. Based on the findings of these analyses, a conceptual model for the strategic management of teaching human capital is developed.

The proposed model is structured around three interconnected dimensions: attraction, stabilization, and professional regeneration. These dimensions were identified through the synthesis of findings from the literature and the analysis of the structural challenges affecting educational human resources.

Several limitations should be acknowledged. The study relies primarily on aggregated statistical data and institutional reports and does not include primary data collected from teachers, school leaders, or educational administrators. Furthermore, the proposed model is conceptual in nature and has not been empirically tested using quantitative methods. Nevertheless, the approach provides a useful framework for understanding the long-term challenges associated with the sustainability and regeneration of teaching human capital and may serve as a basis for future empirical research.

4. Results and Discussion

The analysis of teaching human capital in Romania highlights the interaction between demographic, institutional, and workforce-related factors that influence the sustainability of the educational system. Building on the methodological approach presented in the previous section, this part of the study examines key indicators relevant to educational human resource management and discusses their implications for the regeneration of teaching human capital.

Particular attention is given to demographic transformations, the evolution of the teaching workforce, territorial disparities in the distribution of educational resources, and the specific challenges associated with minority language education. These factors are analysed not as isolated phenomena but as interconnected elements shaping the capacity of the educational system to attract, retain, and develop qualified teaching staff.

The findings suggest that the challenges affecting teaching human capital extend beyond issues of workforce size and involve broader questions related to workforce stability, professional sustainability, and long-term policy planning. Based on the interpretation of the analysed indicators, the final part of this section proposes a strategic model designed to support the regeneration of teaching human capital and strengthen the sustainability of the educational system.

4.1. Demographic Transformations and Human Resource Challenges in the Romanian Educational System

The sustainability of teaching human capital in Romania must be examined within the broader context of demographic and structural transformations that have significantly influenced the educational system during the last decades. Similar to other European countries, Romania has experienced a continuous decline in its school-age population, primarily as a result of decreasing birth rates and migration. These demographic developments have altered the demand for educational services and have generated important challenges for educational planning and human resource management.

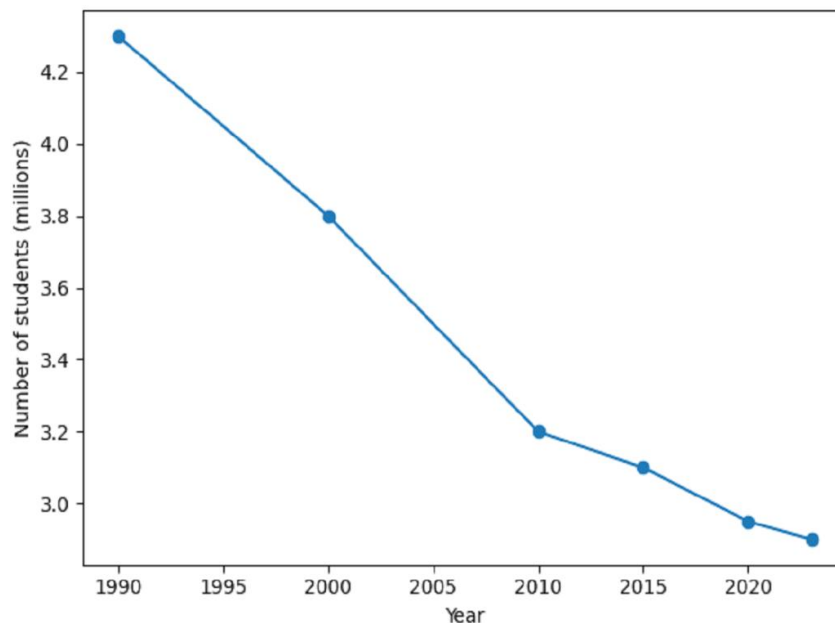


Figure 1. Evolution of the school population in Romania (1990–2023)

Source: Authors' elaboration based on data from the National Institute of Statistics of Romania.

As illustrated in Figure 1, the number of students enrolled in the Romanian educational system has decreased substantially since the early 1990s. This trend reflects a long-term demographic contraction that has affected both the size and the structure of the school network. The reduction in the school population has led to the reorganization of educational

institutions, particularly in rural areas, where declining enrolment has often resulted in school mergers or closures.

From a human resource management perspective, demographic decline has produced complex effects that extend beyond the simple reduction of student numbers. In theory, a smaller school population could reduce the demand for teaching staff. However, the relationship between demographic change and educational human resources is not linear. Educational systems must continue to ensure adequate access to education across different geographical areas and educational levels, regardless of fluctuations in student enrolment.

The evolution of teaching staff in Romania illustrates this complexity. While the number of students has declined significantly, the reduction in the number of teachers has been considerably more moderate. As shown in Figure 3, the two trends have not evolved proportionally, suggesting the existence of structural factors that influence workforce planning. These include the need to maintain educational services in sparsely populated areas, curriculum requirements, and efforts to preserve acceptable teaching conditions despite demographic decline.

At the same time, demographic transformations have generated new challenges for the regeneration of teaching human capital. The ageing of the teaching workforce, combined with difficulties in attracting younger generations to the profession, creates additional pressure on educational institutions. In this context, workforce sustainability depends not only on maintaining an adequate number of teachers but also on ensuring generational renewal and the continuous development of professional competencies.

The Romanian case demonstrates that demographic decline does not automatically eliminate human resource challenges within education. On the contrary, it may create new vulnerabilities related to workforce distribution, recruitment, and long-term planning. Consequently, educational human resource management must move beyond reactive administrative measures and adopt a strategic perspective capable of anticipating future demographic and labour market developments.

These findings suggest that the regeneration of teaching human capital should be considered a long-term policy priority. Addressing demographic challenges requires not only adjustments in workforce size but also coordinated measures aimed at attracting new teachers, supporting professional integration, and ensuring the long-term stability of the teaching profession.

4.2. Analysis of Educational Human Resource Indicators

The indicators analysed in this study reveal several structural trends affecting educational human resources both internationally and within the Romanian educational system. Together, these trends provide a broader understanding of the challenges associated with workforce sustainability, teacher retention, and the long-term regeneration of teaching human capital.

Teacher shortages have become an increasingly visible concern across educational systems worldwide. As shown in Figure 2, the proportion of students enrolled in schools where principals report insufficient teaching staff increased significantly between 2015 and 2022 in OECD countries. This development suggests that difficulties related to teacher recruitment and retention are no longer isolated institutional problems but represent a structural challenge affecting educational systems internationally. The growing scale of teacher shortages indicates that traditional recruitment approaches may no longer be sufficient and that more comprehensive strategies are required to ensure workforce sustainability.

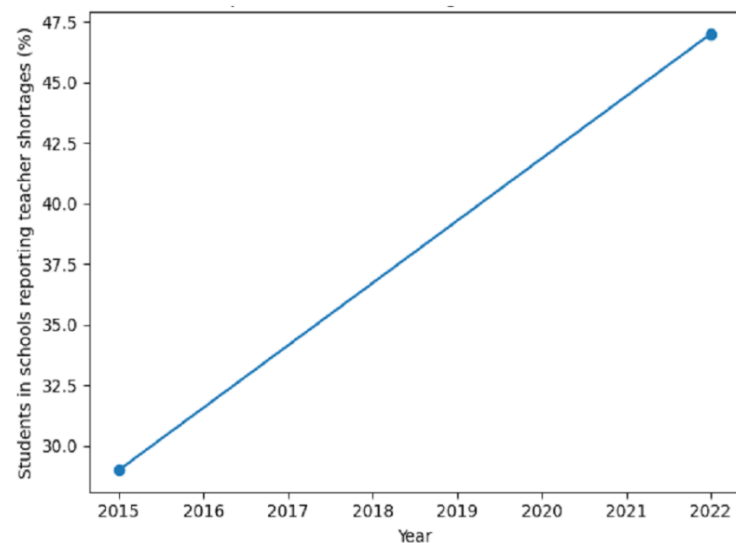


Figure 2. Trend of reported teacher shortages in OECD countries (2015–2022)

Source: OECD Education Policy Outlook (2024)

The Romanian educational system reflects some of these broader international trends, although within a specific demographic context. As illustrated in Figure 3, the decline in the school-age population has not been accompanied by a proportional reduction in the number of teachers. At first glance, this situation could suggest a reduction in pressure on educational human resources. However, a closer examination indicates that demographic decline does not automatically eliminate workforce challenges. Educational institutions must continue to ensure access to education across diverse geographical areas and educational levels, regardless of fluctuations in student numbers. Consequently, workforce planning remains a complex process that cannot be based solely on demographic indicators.

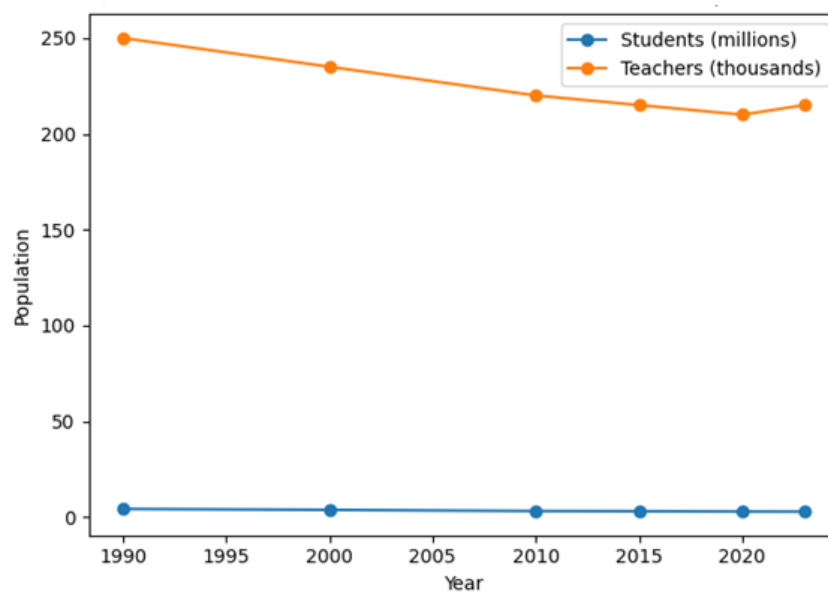


Figure 3. Evolution of students and teachers in Romania (1990-2023)

Source: Authors' elaboration based on data from the National Institute of Statistics of Romania and the Ministry of Education of Romania.

The student–teacher ratio is a key indicator for assessing human resource capacity in education. Comparative data indicate that Romania records a higher student–teacher ratio than the European Union average, suggesting increased pressure on the educational workforce. This indicator reflects both demographic trends and the organizational characteristics of the education system, emphasizing the importance of effective policies aimed at teacher recruitment, retention, and workforce sustainability.

Additional insights emerge from the analysis of the student–teacher ratio presented in Figure 4. This indicator is frequently used to assess the availability of teaching resources and the capacity of educational systems to provide effective learning conditions. Comparative data indicate differences between Romania and the European Union average, reflecting variations in the organization of educational services and the allocation of human resources. While student–teacher ratios alone do not determine educational quality, they may signal pressures on teaching staff and highlight potential difficulties in maintaining adequate educational support for students.

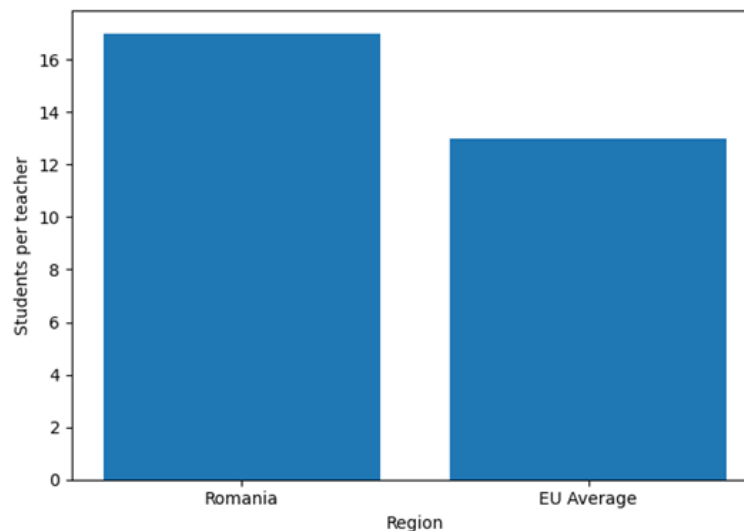


Figure 4. Student – teacher ratio: Romania versus EU average (recent years)

Source: Authors' elaboration based on data from OECD (Education at a Glance) and Eurostat.

The territorial distribution of teachers also represents an important dimension of educational human resource management. As shown in Table 1, teaching staff are unevenly distributed between urban and rural areas. Such disparities may contribute to difficulties in filling vacancies in certain regions and can affect the capacity of schools to attract and retain qualified personnel. In rural communities, workforce shortages are often compounded by demographic decline, limited professional opportunities, and reduced access to support services, creating additional barriers to workforce stability.

Taken together, these indicators suggest that the challenges affecting teaching human capital cannot be explained by a single factor. Rather, they result from the interaction of demographic trends, workforce distribution patterns, institutional conditions, and broader labour market dynamics. This finding supports the argument that educational human resource management requires an integrated and long-term perspective. Policies focused exclusively on recruitment or workforce allocation are unlikely to provide sustainable solutions unless they are accompanied by measures aimed at professional stabilization and continuous regeneration of teaching human capital.

Table 1. Distribution of teaching staff between urban and rural areas

Environment	Estimated number of teachers	Percentage (%)
Urban	150000	68
Rural	70000	32

Source: Authors' elaboration based on data from the National Institute of Statistics of Romania and the Ministry of Education of Romania.

The analysis also highlights the importance of moving beyond short-term responses to staffing difficulties. Sustainable educational systems require not only an adequate number of teachers but also mechanisms capable of supporting workforce stability, professional development, and generational renewal. These considerations provide the foundation for the strategic model proposed in the following sections.

4.3. Human Resource Management Challenges in Minority Language Education

Education in minority languages represents an important component of the Romanian educational system, contributing to the protection of cultural diversity and to the exercise of the right to education in one's mother tongue. Through a network of educational institutions operating in minority languages, the system supports both educational inclusion and the preservation of linguistic and cultural identity. At the same time, this segment of education presents particular challenges from the perspective of human resource management.

Unlike the general education system, minority language education requires teaching staff who possess not only pedagogical qualifications but also the linguistic competencies necessary to teach specific subjects in the respective language. As a result, the recruitment pool for these positions is considerably more limited. The availability of qualified candidates depends on the capacity of higher education institutions to prepare future teachers with the required linguistic and professional competencies, as well as on the attractiveness of the teaching profession for graduates belonging to minority communities.

From a human capital perspective, this situation highlights the importance of considering not only the quantity of educational personnel but also the availability of specialized competencies. While demographic decline may reduce the overall demand for teachers in certain regions, it does not necessarily reduce the demand for qualified staff in minority language education. In some cases, difficulties in recruitment may persist despite declining student enrolment because the supply of teachers with the required qualifications remains limited.

Additional challenges arise from the geographical distribution of educational institutions providing instruction in minority languages. In certain areas, teachers may be required to work in multiple schools in order to complete their teaching workload, increasing professional mobility and creating additional organizational pressures. Such arrangements may affect job stability, professional satisfaction, and long-term retention, particularly among early-career teachers.

The literature on educational human resource management suggests that workforce sustainability depends not only on recruitment but also on the capacity of institutions to retain

and develop qualified personnel. In the case of minority language education, this objective becomes particularly important because replacing specialized staff may require considerably more time and resources than in the general education system. Consequently, workforce instability may have a stronger impact on educational continuity and institutional performance.

The Romanian experience illustrates how specialized educational segments can reveal structural vulnerabilities that are not always visible when analysing aggregate indicators alone. The challenges associated with minority language education demonstrate that effective human resource management must take into account the diversity of educational contexts and the specific characteristics of different categories of teaching staff. These findings further support the need for integrated strategies aimed at attracting, stabilizing, and regenerating teaching human capital across the entire educational system.

4.4. A Strategic Model for Teaching Human Capital Regeneration

The analysis presented in the previous sections suggests that the challenges affecting teaching human capital are complex and cannot be effectively addressed through isolated interventions. International reports and recent research consistently highlight teacher shortages, workforce ageing, retention difficulties, and the growing need for continuous professional development (European Commission, 2023; OECD, 2024; UNESCO, 2024). However, these challenges are often addressed through separate policy measures, with recruitment, retention, and professional development treated as distinct areas of intervention.

This fragmented approach presents important limitations. Policies designed to increase recruitment may temporarily alleviate staffing shortages, but their impact remains limited if newly recruited teachers leave the profession during the early stages of their careers. Similarly, retention initiatives may improve workforce stability in the short term, yet their effectiveness can be reduced if teachers have limited opportunities for professional growth and career advancement. As a result, educational systems may continue to experience workforce instability despite significant investments in individual policy measures (World Bank, 2023).

Another limitation concerns the predominantly short-term orientation of many educational workforce policies. Existing approaches frequently focus on addressing immediate staffing needs without sufficiently considering long-term demographic trends, generational renewal, and the continuous development of professional competencies. In this context, workforce sustainability requires a broader perspective that extends beyond recruitment and retention and incorporates the long-term regeneration of teaching human capital.

The findings of this study support the view that teaching human capital should be understood as a dynamic strategic resource requiring continuous regeneration throughout the professional lifecycle. Building on this perspective, a strategic model for teaching human capital regeneration is proposed. The model, shown in Figure 5, integrates three complementary dimensions - attraction, stabilization, and professional regeneration - within a unified framework aimed at strengthening educational workforce sustainability and supporting the long-term resilience of educational systems.

The first dimension, attraction, focuses on increasing the attractiveness of the teaching profession and expanding the pool of potential entrants. Research suggests that recruitment challenges are influenced not only by salary levels but also by professional prestige, career prospects, and opportunities for professional fulfilment (OECD, 2023; European Commission, 2023). Consequently, attraction policies may include stronger partnerships between

universities and schools, scholarship programmes, targeted recruitment initiatives, and measures designed to improve the public image of the teaching profession.

The second dimension, stabilization, addresses the critical transition from initial recruitment to long-term professional integration. The literature indicates that the early years of a teaching career are associated with a higher risk of attrition, making this stage particularly important for workforce sustainability (OECD, 2024; UNESCO, 2024). Effective stabilization strategies may therefore include mentoring programmes, structured induction processes, reduced professional isolation, and measures aimed at improving working conditions and reducing employment instability.

The third dimension, professional regeneration, emphasizes the continuous development and renewal of professional competencies throughout the teaching career. While continuous professional development is widely recognized as an important component of educational quality, it is often treated as a separate activity rather than as an integral element of workforce sustainability (World Bank, 2023; UNESCO, 2024). The proposed model views professional regeneration as a continuous process that supports career development, strengthens professional motivation, and enables teachers to respond effectively to changing educational and societal demands.

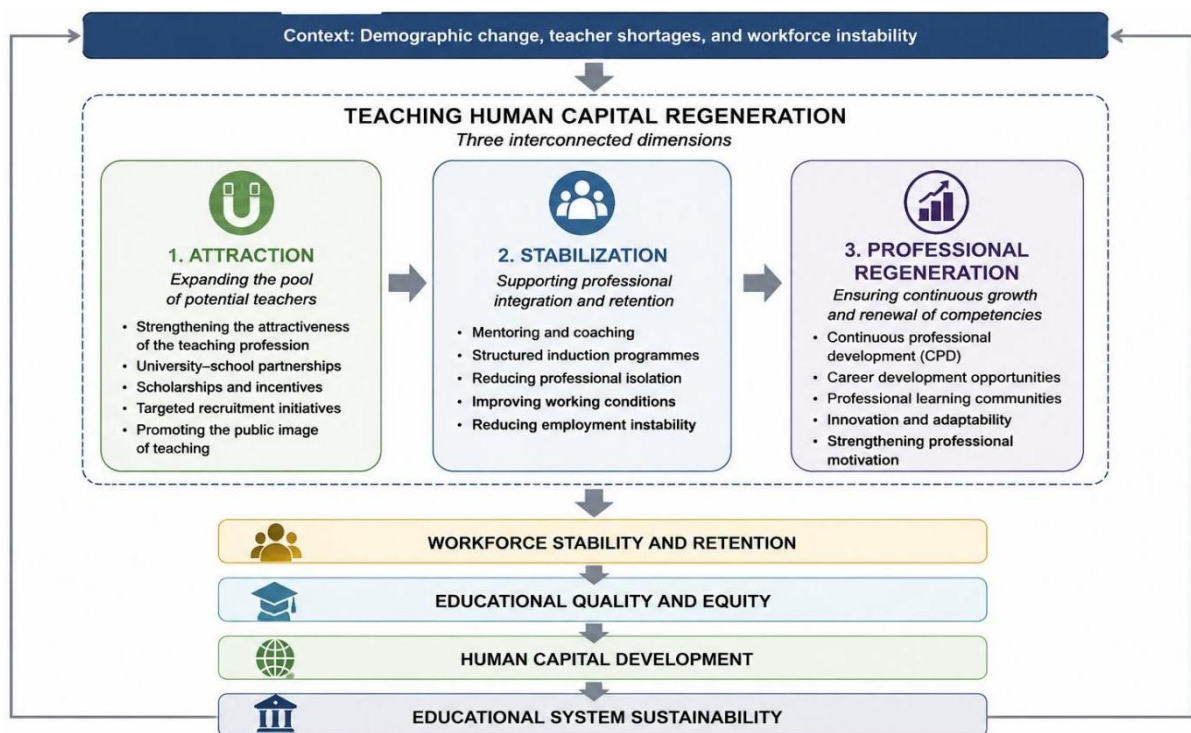


Figure 5. Strategic Model for Teaching Human Capital Regeneration

Source: Author's illustration, edited with the assistance of artificial intelligence.

Unlike many existing approaches that focus primarily on recruitment or retention, the proposed model integrates the entire professional trajectory of teachers within a single conceptual framework. This perspective reflects the dynamic nature of teaching human capital and acknowledges that workforce sustainability depends on the interaction between attraction, stabilization, and continuous professional development. The model therefore addresses one of

the key gaps identified in the literature, namely the limited integration of these dimensions within a coherent strategy for educational human resource management. The originality of the proposed model lies not in the individual dimensions themselves, which have been discussed separately in the literature, but in their integration within a single framework focused on the continuous regeneration of teaching human capital. This perspective shifts the focus from isolated workforce interventions to a long-term sustainability approach that connects recruitment, professional integration, and career-long development.

From a policy perspective, the model suggests that sustainable educational systems require coordinated interventions across all stages of the teaching career. Isolated measures are unlikely to generate lasting improvements unless they are supported by broader strategies that strengthen workforce stability, professional growth, and generational renewal. Consequently, the regeneration of teaching human capital should be understood as a long-term investment in educational quality, human capital development, and institutional sustainability.

5. Conclusions

The sustainability of educational systems depends to a large extent on their capacity to attract, retain, and continuously develop qualified teaching personnel. In knowledge-based economies, teaching human capital represents not only a key educational resource but also a strategic asset for economic development, social cohesion, and the long-term formation of human capital. In the context of demographic decline, workforce ageing, teacher shortages, and increasing labour market competition, the regeneration of teaching human capital has become a strategic priority for educational policy and public sector human resource management.

The analysis conducted in this study demonstrates that the challenges affecting teaching human capital in Romania extend beyond issues related to workforce size. They also involve territorial disparities, workforce stability, professional attractiveness, and the long-term capacity of the educational system to ensure generational renewal. These challenges are particularly significant in specialized educational segments, including minority language education, where recruitment opportunities are more limited and workforce sustainability depends on a relatively narrow pool of qualified personnel.

The review of the literature revealed that recruitment, retention, and professional development are often examined as separate policy domains. While existing studies provide valuable insights into each of these dimensions, they offer a more limited understanding of the interactions between them. This study contributes to the literature by approaching teaching human capital from the perspective of continuous regeneration and by proposing a strategic model that integrates attraction, stabilization, and professional regeneration within a single framework.

Based on the analysis of educational indicators and the structural challenges affecting the Romanian educational system, the proposed model emphasizes the need for integrated and long-term policies capable of supporting both the recruitment of new teachers and the professional development and retention of existing personnel. The findings suggest that educational sustainability should be approached not only as a matter of institutional performance but also as a long-term investment in human capital. Policies aimed at strengthening the stability and quality of the teaching workforce may contribute to improving educational outcomes, increasing the efficiency of public investment in education, and supporting broader socio-economic development.

Several limitations should be acknowledged. The study relies primarily on documentary analysis and secondary statistical data obtained from institutional sources and does not include empirical evidence collected directly from teachers, school leaders, or educational institutions. In addition, the proposed model is conceptual in nature and has not been empirically validated. Future research could test its applicability through quantitative analyses, comparative studies, and case studies conducted in different educational contexts. Such investigations could contribute to a deeper understanding of the factors that influence the attraction, stabilization, and regeneration of teaching human capital and support the development of more effective educational policies.

Overall, the paper argues that the regeneration of teaching human capital should be regarded as a strategic investment and a fundamental condition for ensuring the long-term quality, resilience, and sustainability of educational systems.

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TEXTILE WASTE VALORIZATION IN THE CONTEXT OF CIRCULAR ECONOMY: OPPORTUNITIES FOR SUSTAINABLE BUSINESS DEVELOPMENT IN MOLDOVA

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Abstract: *The increasing generation of textile waste has become a significant environmental and economic challenge worldwide, driven by rapid consumption patterns and the expansion of the fashion industry. In the context of the transition toward a circular economy, textile waste valorization is gaining increasing attention as a strategic approach to reducing environmental impacts while creating new economic opportunities. This study explores the potential of textile waste valorization as a pathway for supporting sustainable business development, with a particular focus on emerging circular economy systems such as the Republic of Moldova. The research is based on a qualitative analytical approach, including the review and synthesis of scientific literature, policy documents, and existing industry practices. The paper identifies and systematizes the main sources of textile waste, distinguishing between pre-consumer and post-consumer streams, and analyzes key valorization pathways, including direct reuse, upcycling, material recycling, industrial applications, and energy recovery. The findings highlight the importance of adopting a hierarchical and integrated approach to textile waste management in order to maximize resource efficiency and value retention. Furthermore, the study proposes a conceptual framework for the integration of textile waste valorization into circular value chains and outlines key opportunities for sustainable business development in Moldova. The results emphasize the need for stronger collaboration between academia, industry, and policymakers, as well as the development of supportive infrastructure and regulatory mechanisms to facilitate the transition toward a circular and resilient economy.*

Keywords: *circular economy, textile waste; valorization, sustainable business, resource efficiency, recycling, innovation.*

Classification JEL: Q53, Q01, O44.

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1. Introduction

In recent decades, the rapid expansion of the textile and fashion industry has led to a substantial increase in global textile waste generation. Driven by accelerated consumption patterns, short product life cycles, and the rise of fast fashion, textile waste has become a critical environmental and resource management challenge at the global scale.

Traditionally, textile waste has been managed within a linear “take-make-dispose” economic model, resulting in significant material losses and environmental pressure. In response, the transition toward a Circular Economy has gained momentum, emphasizing resource efficiency, waste minimization, and the reintegration of secondary materials into production systems.

Within this paradigm, textile waste valorization has emerged as a strategic approach, encompassing reuse, recycling, and the development of alternative applications for textile residues. These processes contribute to the formation of circular value chains and support the emergence of sustainable and resource-efficient business models.

In economies with developing circular economy frameworks, including the Republic of Moldova, the implementation of integrated textile waste management systems remains at an early stage. The absence of a centralized collection infrastructure and limited processing capacities significantly constrain effective textile waste management. Despite the economic relevance of the textile sector, the majority of textile waste is still directed to municipal landfills or handled without adequate material recovery. This structural gap underscores the necessity of improved analytical frameworks for textile waste flows and the identification of viable valorization pathways.

Against this background, the present study aims to analyse the potential of textile waste valorization as a mechanism for supporting circular economy development and fostering sustainable business opportunities, with a particular focus on the Republic of Moldova.

2. Literature Review

The growing environmental impact of textile production and consumption has attracted increasing attention from researchers and policymakers in recent years. The textile and fashion industry is considered one of the most resource-intensive sectors, characterized by high consumption of raw materials, water, and energy, as well as significant waste generation (Ellen MacArthur Foundation, 2017). As a result, textile waste management has emerged as a critical research frontier within the broader frameworks of waste management and the circular economy (European Environment Agency, 2024, May).

Traditional waste management systems were primarily focused on end-of-pipe disposal practices, such as landfilling and incineration. However, these approaches are increasingly viewed as unsustainable due to their negative environmental externalities and the inefficient loss of valuable resources (Ghisellini, P., Cialani, C., & Ulgiati, S., 2016). In response, researchers have emphasized the necessity of transitioning from “take-make-dispose” linear models toward circular economic systems that prioritize waste prevention, reuse, and resource recovery (Geissdoerfer, M., Savaget, P., Bocken, N. M., & Hultink, E. J., 2017; Scricpenco, A., & Pashkevich, K., 2020).

Within the circular economy framework, the concept of waste valorization has emerged as a pivotal strategy for transforming waste materials into high-value resources (Arshadi, M.,

et al., 2020). Valorization involves diverse processes that reintegrate waste into production cycles, thereby reducing the demand for virgin raw materials and mitigating environmental pressures. In the textile sector, these strategies encompass the reuse of garments, upcycling, material recycling, and the application of textile residues in cross-industrial processes (Bocken, N. M. P., de Pauw, I., Bakker, C., & van der Grinten, B., 2016).

While several studies highlight the potential of advanced recycling technologies and innovative fiber recovery, researchers argue that technological solutions alone are insufficient to address the systemic challenges of textile waste (Sandin, G., & Peters, G. M., 2018). Effective management requires a holistic shift involving supply chain restructuring, novel business models, and shifts in consumer behavior (Niinimäki, K., Peters, G., Dahlbo, H., Perry, P., Rissanen, T., & Gwilt, A., 2020). Another vital research direction concerns the development of circular value chains, which aim to extend product lifecycles through repair, remanufacturing, and closed-loop recycling (Graur, I. V., Scripcenco, A., Avadanei, M., Florea-Burduja, E., Vatra, A. D., & Roşca, M. I., 2025; Stahel, W. R., 2016).

Despite the expanding body of literature, research remains heavily skewed toward the technical aspects of recycling. Less attention has been dedicated to the systematization of valorization pathways and their role in supporting sustainable business development, particularly in emerging economies (World Bank, 2022). Consequently, further research is required to analyze how diverse valorization strategies can catalyze circular models and create opportunities for sustainable entrepreneurship. Such analysis is especially pertinent for countries like Moldova, where the transition to a circular economy is in its nascent stages but offers significant potential for innovation through collaboration between academia, industry, and policymakers (Popovici, A., & Catan, P., 2021; Scripcenco, A., 2025, April).

This analysis is particularly urgent for the Republic of Moldova, where the textile sector represents a strategic branch of the national economy but faces an acute lack of infrastructure for managing post-industrial and post-consumer waste. The transition toward a circular economy in Moldova is supported by a regulatory framework currently being aligned with European Union directives, specifically through the implementation of Extended Producer Responsibility (EPR) (Ministerul Mediului al Republicii Moldova, 2023). However, practical implementation remains fragmented. Recent studies indicate that most local textile companies are limited to exporting waste or disposing of it through landfilling, thereby missing the economic potential of domestic valorization (World Bank, 2022). There is a significant gap between environmental policies and the technological capacity of SMEs to adopt upcycling or chemical recycling solutions. Therefore, developing an ecosystem based on collaboration between academia, the industrial sector, and policymakers is essential to transform textile waste from an environmental problem into a resource for industrial innovation, aligning the local industry with the standards of the European Green Deal (European Commission, 2020).

3. Methodology

This study applies a qualitative analytical approach aimed at examining the potential of textile waste valorization within the framework of the Circular Economy and its implications for sustainable business development. The research is based on the analysis and synthesis of scientific literature, policy reports, and existing practices related to textile waste management and resource recovery.

The methodological framework includes several complementary research methods. First, a **literature review** was conducted to identify key concepts and current research trends related to textile waste management, valorization strategies, and circular economic models. This step allowed the identification of the main approaches used in recent studies and the determination of existing research gaps.

Second, a **comparative analysis** of different textile waste valorization pathways was carried out in order to systematize the main strategies applied in the textile and fashion industries. Particular attention was given to approaches that enable the transformation of textile waste into valuable secondary resources, including reuse, upcycling, material recycling, and industrial applications.

Third, the study employs **conceptual modelling** to illustrate the integration of textile waste valorization processes into circular value chains. The proposed conceptual framework highlights the relationships between textile waste generation, valorization pathways, and potential opportunities for sustainable business development.

This methodological approach makes it possible to analyse textile waste valorization from a systemic perspective and to identify opportunities for improving resource efficiency and promoting circular economic practices, particularly in emerging contexts such as Moldova.

4. Results and Discussion

Sources and Types of Textile Waste

The analysis of textile waste streams reveals that the textile and fashion industry generates substantial volumes of waste at multiple stages of the product lifecycle. From a circular economy perspective, the identification and classification of these waste streams represent a critical prerequisite for designing effective valorization strategies and optimizing resource recovery processes.

Estimates of textile waste generation in the Republic of Moldova vary significantly depending on the methodology used. According to modeling approaches based on consumption patterns and European benchmarks, total textile waste generation is estimated at **50,000–55,000 tons annually** (European Environment Agency, 2024, May).

However, more conservative assessments, including data reported within national circular economy initiatives such as e-Circular (Centrul de instruire şi consultanţă e-Circular. (2026), indicate lower values of approximately **30,000 tons per year**, reflecting only the officially recorded or managed waste streams.

This discrepancy highlights a substantial data gap and suggests that a significant share of textile waste remains unaccounted for due to the lack of separate collection systems and incomplete monitoring. Consequently, actual textile waste generation in Moldova is likely underestimated in official statistics.

Textile waste can be broadly categorized into **pre-consumer** and **post-consumer waste**, each characterized by distinct properties and implications for valorization. According to data from the European Environment Agency, **post-consumer textile waste accounts for approximately 82% of the total textile waste stream**, while the remaining share corresponds to pre-consumer and industrial waste (European Environment Agency, 2024, May).

Pre-consumer textile waste originates within industrial production processes, including fiber processing, yarn manufacturing, fabric formation, and garment assembly. This category comprises fabric offcuts, defective materials, trimming waste, and unsold inventory. Due to its relatively homogeneous composition and predictable material characteristics, pre-consumer waste is particularly suitable for high-value recycling and reintegration into industrial production cycles. From a business perspective, this type of waste represents a readily accessible resource for implementing closed-loop production systems and improving material efficiency.

In contrast, post-consumer textile waste consists of textile products discarded after use, including clothing, household textiles, and other fabric-based items. This waste stream is significantly more heterogeneous, often containing mixed fibers, varying levels of wear, and contamination. As a result, it requires more complex processes such as sorting, classification, and cleaning prior to valorization. Despite these challenges, post-consumer waste represents a substantial untapped resource within circular economy systems, particularly in emerging markets where collection and processing infrastructures are still underdeveloped.

In addition, industrial textile waste generated from technical textiles and specialized applications introduces further complexity due to the presence of composite materials and nonwoven structures. These materials often require advanced processing technologies but also offer opportunities for cross-sectoral valorization in industries such as construction, automotive, and environmental engineering.

Table 1. Estimated textile waste flows in the Republic of Moldova

Waste category	Source	Estimated share (%)	Material composition	Current management practice	Valorization potential
Pre-consumer waste	Garment manufacturing	20–30	Cotton, polyester, blends	Partial reuse (internal), disposal	High (reuse, recycling)
Cutting scraps	Cutting processes	10–20 (of material)	Mostly homogeneous fabrics	Limited reuse	Very high (recycling, upcycling)
Production defects	Sewing/finishing	5–10	Mixed materials	Disposal or secondary use	Medium
Post-consumer waste	Households	50–60	Highly heterogeneous	Landfill	Medium (requires sorting)
Second-hand waste	Imported used clothing	20–30	Worn mixed textiles	Disposal	Low–medium
Commercial waste	Retail sector	5–10	Unsold garments	Discounting / disposal	High (reuse, donation)
Total textile waste	National level	~100	Mixed	>90% landfill	Underutilized

Source: Developed by the authors

The increasing volume and diversity of textile waste streams highlight the limitations of traditional linear waste management approaches. The continued reliance on landfilling and incineration leads to significant losses of material value and contributes to environmental

degradation. In contrast, the circular economy framework emphasizes the need to treat textile waste as a resource rather than a disposal problem.

In this context, the classification of textile waste is not merely a descriptive exercise but a strategic tool that enables the alignment of specific waste streams with appropriate valorization pathways. This alignment is essential for the development of efficient circular value chains and for maximizing both environmental and economic benefits.

During the study, an analysis of the structure of textile waste flows in the Republic of Moldova was carried out, including their sources, composition, and recycling potential, as presented in Table 1.

Pathways for Textile Waste Valorization

The systematization of textile waste valorization pathways provides a structured understanding of how waste materials can be transformed into valuable resources within circular economic systems. Based on the analysis of existing research and industry practices, several key pathways can be identified, differing in terms of technological complexity, value retention, and economic potential.

A hierarchical approach to valorization reveals that strategies such as **direct reuse and upcycling** generally preserve the highest level of product value, while **recycling and energy recovery** involve progressively greater material transformation and value loss. This hierarchy is consistent with the principles of the circular economy, which prioritize resource efficiency and lifecycle extension.

Direct reuse represents the most resource-efficient strategy, as it requires minimal processing and preserves the original function of textile products. The expansion of second-hand markets and clothing exchange systems can significantly reduce the demand for new production. In the context of Moldova, the development of organized reuse systems remains limited, indicating a clear opportunity for business innovation and infrastructure development.

Creative reuse and upcycling introduce additional value through design and innovation. This pathway is particularly relevant for small and medium-sized enterprises, designers, and social enterprises, as it combines environmental benefits with economic and cultural value creation. Upcycling practices can contribute to the development of niche markets and support the growth of sustainable fashion initiatives.

Material recycling enables the recovery of fibers and their reintegration into new production cycles. While this approach contributes significantly to resource efficiency, it is often constrained by technological limitations, especially in the case of blended materials. In Moldova, the lack of local recycling infrastructure represents a major barrier, resulting in the export or disposal of textile waste rather than its domestic valorization.

Industrial applications offer an alternative pathway for utilizing textile waste in non-fashion sectors. The transformation of textile residues into insulation materials, geotextiles, or composite components illustrates the potential for cross-industry integration. This diversification of applications enhances the resilience of circular systems and reduces dependence on single-sector solutions.

Finally, **energy recovery** represents the least preferred option within the circular hierarchy, as it involves the destruction of material value. However, it remains a relevant solution for waste

streams that cannot be effectively reused or recycled. From a sustainability perspective, energy recovery should be considered a complementary rather than primary strategy.

The comparative analysis of these pathways demonstrates that the effectiveness of textile waste valorization depends on the integration of multiple strategies within a coherent system. Isolated solutions are insufficient; instead, a systemic approach is required to optimize material flows and maximize value retention.

As a result of the study, the main ways of recycling textile waste were summarized and presented in Table 2.

Table 2. Main Pathways of Textile Waste Valorization

Valorization pathway	Description	Examples
Direct reuse	Reuse of textile products without significant processing	Second-hand clothing, donation, clothing exchange
Creative reuse (upcycling)	Transformation of textile waste into new products with higher value	Fashion design, accessories, decorative objects
Material recycling	Recovery of fibers for the production of new textile materials	Recycled yarns, recycled fabrics
Industrial applications	Use of textile residues in non-fashion industrial sectors	Insulation, filling materials, geotextiles
Energy recovery	Use of textile waste as a secondary energy resource	Thermal energy recovery

Source: Developed by the authors

The identification and classification of textile waste valorization pathways provide a conceptual basis for analysing how such strategies may contribute to the development of sustainable business initiatives and circular economic practices. These opportunities are particularly relevant for countries with emerging circular economy systems, such as Moldova.

Based on the conducted research and analysis of possible ways of processing textile waste in the Republic of Moldova, we have developed a conceptual model for the valorization of textile waste within the framework of a circular economy (Figure 1)

Opportunities for Sustainable Business Development in Moldova

The transition toward a circular economy creates significant opportunities for sustainable business development, particularly in emerging markets such as Moldova. The valorization of textile waste can serve as a catalyst for innovation, enabling the creation of new business models, value chains, and economic activities.

One of the most promising areas is the development of **reuse-based business models**, including second-hand retail, repair services, and clothing rental systems. These models extend product lifecycles while generating economic value from existing resources.

Another important opportunity lies in **upcycling and creative industries**, where textile waste is transformed into high-value products. This sector is particularly accessible for small enterprises and startups, requiring relatively low investment while offering strong differentiation through design and sustainability.

The establishment of **recycling infrastructure** represents a more capital-intensive but strategically important direction. Developing local capacities for textile recycling would

reduce dependence on external markets and enable the creation of domestic circular supply chains.

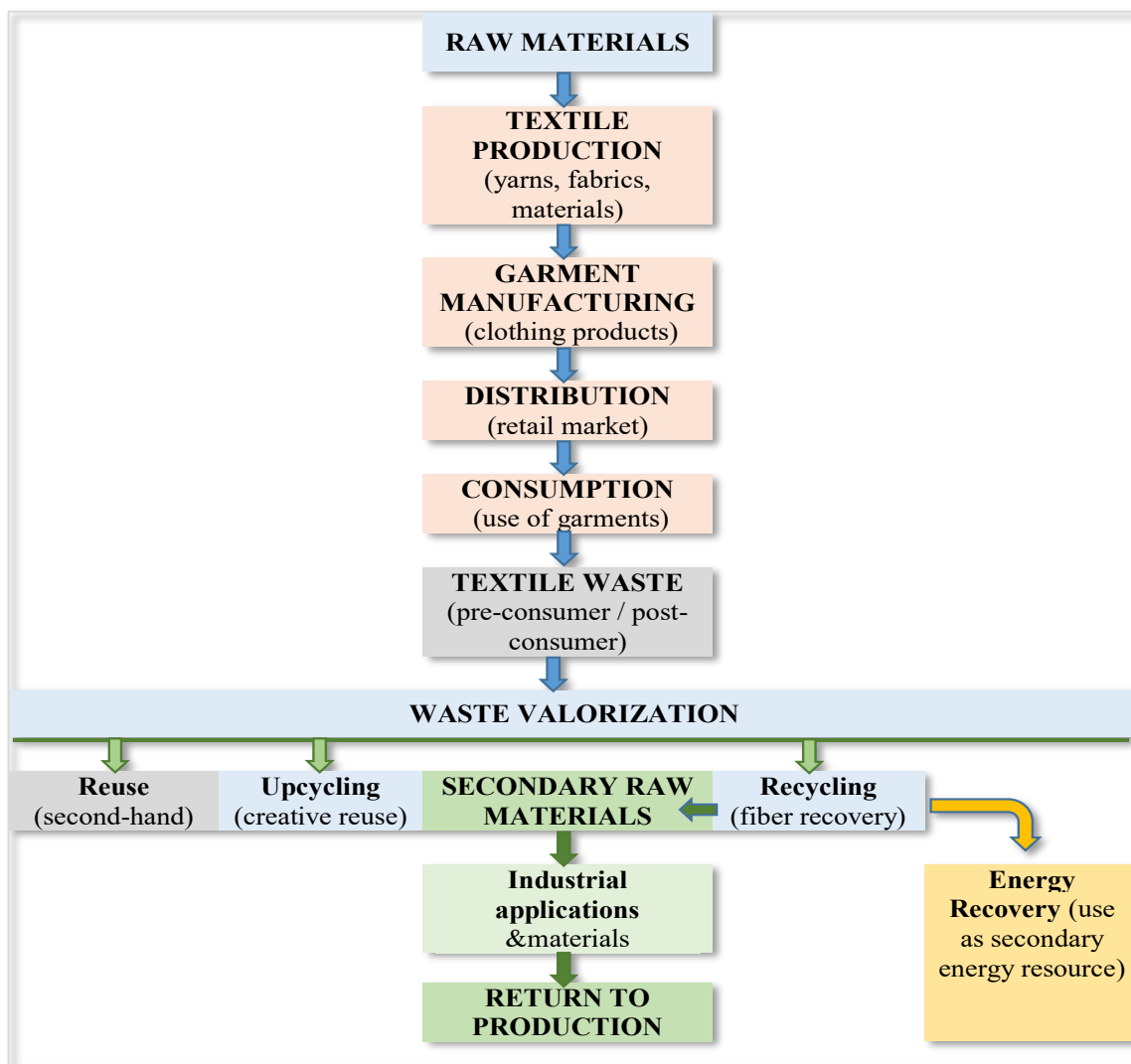


Figure 1. Proposed Conceptual Framework for Textile Waste Valorization

Source: Developed by the first authors

Furthermore, the integration of textile waste into **industrial applications** opens new avenues for cross-sector collaboration. Partnerships between textile producers and industries such as construction or automotive manufacturing can facilitate the development of innovative materials and products.

Despite these opportunities, several challenges remain, including limited infrastructure, lack of technological capabilities, and insufficient coordination between stakeholders. Therefore, the development of an effective circular textile system in Moldova requires a collaborative approach involving academia, industry, and public authorities. In this context, universities and research institutions play a key role in knowledge generation and innovation, while policymakers are responsible for creating supportive regulatory frameworks. Businesses, in turn, act as drivers of implementation, translating circular economy principles into practical solutions.

Overall, the findings suggest that textile waste valorization has the potential to become a strategic component of sustainable economic development in Moldova. However, its successful implementation depends on the creation of an integrated ecosystem that supports innovation, investment, and collaboration.

5. Conclusions

The growing volume of textile waste represents not only an environmental burden but also a significant untapped resource within emerging circular economy systems. This study has demonstrated that the transition from linear to circular models in the textile sector requires a fundamental rethinking of waste, shifting its perception from a disposal problem to a valuable input for new production and business processes.

The analysis of textile waste streams highlights their structural complexity, emphasizing the importance of distinguishing between pre-consumer and post-consumer waste in order to design efficient valorization strategies. Furthermore, the systematization of textile waste valorization pathways provides a comprehensive framework for understanding how different levels of value recovery - from direct reuse to energy recovery - can be integrated into circular value chains.

A key contribution of this study lies in framing textile waste valorization as a multidimensional process that connects environmental sustainability with economic value creation. By linking valorization pathways with potential business applications, the paper advances understanding of how circular economy principles can be operationalized within the textile and fashion sectors.

In the context of the Republic of Moldova, the findings indicate that textile waste valorization offers substantial opportunities for the development of sustainable business models, particularly in reuse, upcycling, and cross-sector applications. At the same time, the study identifies critical barriers, including limited infrastructure, technological constraints, and insufficient stakeholder coordination. Addressing these challenges requires a systemic approach supported by coherent public policies, investment in innovation, and strengthened institutional capacities.

From a policy perspective, the implementation of circular economy strategies in the textile sector should be supported through targeted regulatory instruments such as extended producer responsibility schemes, incentives for recycling and reuse initiatives, and the development of national textile waste management frameworks. In parallel, strengthening collaboration between academia, industry, and government institutions is essential for accelerating knowledge transfer and enabling innovation uptake.

The study also identifies several directions for future research. Further empirical investigations are needed to assess the economic feasibility of specific valorization pathways in the Moldovan context, as well as to examine consumer behavior and its influence on textile waste generation and reuse practices. In addition, the development of quantitative models for measuring environmental and economic impacts of textile waste valorization would provide valuable support for evidence-based policymaking.

In conclusion, textile waste valorization has the potential to become a strategic driver of sustainable development and circular transformation in the Republic of Moldova. Its successful implementation depends on the creation of an integrated ecosystem that aligns technological capacity, business innovation, and policy support. Such an approach would

not only reduce environmental pressures but also generate new opportunities for economic resilience and sustainable growth.

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DIGITALIZATION OF PUBLIC ADMINISTRATION AS A TOOL TO REDUCE CORRUPTION RISKS

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Abstract: Corruption is one of the main vulnerabilities faced by public administration, which has the effect of diminishing citizens' trust in public institutions and the efficiency with which the decision-making process is carried out. The digitalization of services offered by state institutions has become in recent years, one of the most important tools for preventing corruption risks by increasing transparency and reducing direct contact between public official and citizens. In the context of the rapid development of digital tools, public institutions in Romania have the opportunity to become much more transparent and to offer much better quality services to citizens through the use of technology. Digitalization promises greater transparency but also, higher efficiency of public acts. Although the phenomenon of corruption cannot be completely eliminated, a number of measures can be taken to keep it under control. This article analyzes the role that digitalization has in terms of corruption risk management, also highlighting good practices from certain European Union member states. E-government models are implemented in Denmark, Finland and Estonia, these states being recognized for their high level of administrative digitalization and for their performance in the field of public integrity. This paper also examines the role of e-Government solutions in reducing corruption risks by minimizing direct interactions between public officials and citizens and increasing traceability of decision-making processes. Digitalization can significantly contribute to reducing the risks of corrupt behaviors and to strengthening decision-making transparency.

Key words: digitalization, e-Government, corruption risks, management, public administration

JEL Classification: M10, M15.

UDC: 004:351 **DOI:** <https://doi.org/10.53486/ser2026.58>

1. Introduction

In an increasingly digital world, as we witness a technological revolution, the use of digital tools has become commonplace nowadays. This digital revolution has profoundly changed the way citizens interact with public administration.

Since all countries in the world are in a constant struggle with corruption, to a greater or lesser extent, it is necessary to identify and use various means to keep it under control. One of these means or tools is digitalization.

The study highlights the connection between digitalization and reducing corruption risks. The phenomenon of corruption represents an obstacle to the smooth functioning of public administration as well as to economic development and the digitalization of public administration represents one of the main methods to contain this scourge. This phenomenon „remains a serious problem for EU citizens: 68% of them believe that corruption is still

widespread in their country” (European Commission, 2022); thus, it is necessary to identify and take solutions to keep corruption under control as much as possible.

The conceptual and methodological framework is presented to more easily understand what the terms of interest in this article imply, such as public administration, digitalization and e-Government, part where we will be able to see if there is a connection between these terms. The level of e-Governance in Romania is highlighted to point out how much Romania has evolved over the years in this area and how e-Government manifests itself in this state. Also, good practices are analyzed regarding the digitalization of public administration and, especially, what is the connection between digitalization and reducing corruption risks.

At the same time, this article aims to highlight the level of digitalization at which our country is compared to other member states of the European Union and we will point out a series of measures that could be taken to further reduce these corruption risks with the help of digital tools.

2. Methodology

This study is based on different research methods such as: deduction, induction, synthesis, analysis in the field of digitalization of public administration and how digital tools can contribute to reducing corruption risks.

Regarding the information base of the research, it is represented by both international and Romanian publications, annual reports of the European Commission on the Digital Economy and Society Index, annual reports of the non-governmental organization Transparency International, as well as other informational resources.

3. Results and discussions

This paper establishes the conceptual foundations necessary for understanding the relationship between digitalization and the reduction of corruption risks in public administration. Public administration is in an interdependent relationship with the concept of public power or authority. Etymologically, the word administration comes from the Latin language "administer" which means servant, caretaker, helper. According to the Romanian dictionary, to administer means to direct, lead, govern, and the noun administration is explained as meaning "the set of administrative authorities that exist in a state, in a section or service, whose competence consists in solving administrative problems, in short, the competence of public administration consists in organizing the execution and concrete execution of laws, but also the act of organizing and carrying out management.

Digitalization has several definitions in the specialized literature, but, generically, digitalization can be defined as a process whose main role is the reformation of an organization or even an entire society, through the use of digital technology. It is easy to understand that the transposition of documents into electronic format involves a simple process of digitalization, this process has proven to be much more complex, a process that also involves a series of challenges that we will analyze in the content of this article.

E-Government is defined as a process by which the public sector reinvents itself through the previously defined tool – digitalization, therefore, there is an interdependent relationship

between digitalization and e-Government. E-Government is described as “a remarkable symbiosis between society and technology” (Iscru, 2025). This concept is closely linked to principles of efficiency, transparency and good governance.

Considering the above, we can understand that e-Government is a process through which digital tools are used to reform public administration and, implicitly, an entire society. By integrating these concepts, the paper builds a theoretical framework that explains how digitalization mechanisms can reduce corruption risks by limiting discretionary power, and strengthening institutional control.

In recent years, in the context of administrative reform, the development of e-Government in Romania has gained increasing attention. Digital transformations within state institutions support the development of e-Government. E-Government involves the use of the internet and digital technology by public institutions for use by both citizens and businesses.

In Romania, e-Government is represented by a set of digital platforms such as: Ghişeu.ro - is an online platform that can be used by citizens to pay taxes and fees for houses, land, cars, local taxes, but also EPPS - (Electronic Public Procurement System) - is an online platform used by institutions or companies for public procurement, a platform administered by the Romanian Digital Agenda Agency. Such digital platforms contribute to increasing transparency and reducing corruption risks. Also “digitalization brings benefits in local public administration both for public institutions and for civil servants and other stakeholders” (Androniceanu et al., 2022).

There are numerous benefits in terms of digitizing public administration: the most important of which we could say is that it refers to the reduction of corruption. Other benefits could consist in the fact that citizens no longer have to travel to public institutions to make certain appointments, to pay taxes or duties, thus the time and effort to carry out these activities being greatly reduced.

Thus, “the digitalization of the public sector involves: reducing the time that citizens naturally allocate to necessary usual activities, reducing costs, reducing bureaucracy, increasing accessibility to public services, improving communication with citizens” (Damaschin & Mihăilă, 2023).

It should be noted that Romania is perceived as one of the most corrupt states in the European Union, along with Hungary and Bulgaria, with Denmark, Finland, and Sweden at the opposite pole, as shown by data published by Transparency International Romania in February 2026. “Romania obtains 45 points out of a possible 100 in the 2025 corruption perception inducement ranking, 1 less than the previous year and well below the EU average of 62 points.” (Transparency International Romania, 2025). In this rank, 100 means very corrupt and 0 means not corrupt at all. Considering these, the e-Government has a very important role, among others, that of reducing corruption risks as much as possible.

At the European Union level, the European Commission monitors the digital progress of member states with the help of the Digital Economy and Society Index (DESI), based on four main pillars: the use of internet services, human capital, connectivity and the integration of digital technologies in enterprises and public administrations.

Thus, annually, the European Commission publishes the Digital Economy and Society Index through reports in order to monitor the level of digitalization of the European Union Member States. In this context, rankings are published periodically that show the situation of the EU Member States according to the level of digitalization, analyzing their progress in recent years.

Starting with 2025, the Digital Economy and Society Index was integrated into the State of the Digital Decade 2025 Report. Romania has made progress in certain areas such as the digitalization of public services, it remained below the European Union average in certain areas such as: connectivity, infrastructure, resulting in the need to take measures to improve access to modern digital infrastructure. According to the latest DESI Reports, our country is constantly warned about the slow pace of implementing digital reforms.

The state that is at the top of the ranking in terms of the degree of digitalization of public services is Estonia, which has obtained full access to the health system - E-Health, which implies that the citizens of this country have electronic medical records, files that are integrated into a national platform, which makes patient data accessible quickly and efficiently, thus being a model for other states, including our country. "Estonia focuses on digital sovereignty" (European Commission, 2025), this being the most digitalized country in the European Union. Estonia is constantly presented as a model of success in terms of digital change, currently „one of the most advanced digitalized societies in the world" (Costache, 2025).

Since the 1990s, Estonia has been investing in digital infrastructure steadily, and today this small country is a true example of an almost fully digitalized state, where public services are accessible to citizens. Digitalization requires not only technology, but also people trained to use it, and the Estonian model also includes developing personnel in the field of digital skills. In addition to Estonia, Finland and Denmark are other countries where the level of digitalization of public administration is high.

As we mentioned earlier, one of the main advantages and even roles of digitalization is represented by the reduction of corruption risks. In many countries of the world there is the so-called „counter corruption" (Iscru, 2025) which consists of offering a bribe in the context of interactions between citizens and public officials.

With the digitalization of public services, e-Government can reduce this form of corruption by introducing digital platforms and, implicitly, eliminating direct interaction between public institution officials and citizens.

With the help of digital tools, citizens receive access to an impressive volume of information and are up to date with decision-making processes, which also means that public administration carries out its activity in the most transparent way possible, thus reducing the risks of corruption. „Technology can increase transparency and accountability in public administration by providing citizens with access to information and decision-making processes" (Comănesci, 2025).

Therefore, in addition to eliminating interactions between civil servants and citizens, digitalization contributes to the transparency and traceability of decision-making processes, making it much easier to track each stage of these decision-making processes with the help of technology.

In order to ensure, as far as possible, the transparency of public acts, on March 26, 2026, the European Parliament adopted the Directive on combating corruption - 2023/0135. As its name suggests, it establishes measures to prevent and combat corruption. The objectives of the Directive include the following: to discourage corruption acts through sanctions proportional to the seriousness of the acts, to criminalize corruption acts in a harmonized manner in all European Union States, to establish measures to ensure transparency and integrity, and not only. Twenty days after its publication in the Official Journal of the EU, this Directive will enter into force and will have to be transposed into national law within 24 months.

Corruption risks can be reduced due to digitalization because the use of artificial intelligence reduces human errors, especially in situations where some "errors" are intentionally produced to mask the commission of possible acts of corruption. For example, in the case of public procurement, a civil servant may intentionally introduce errors or omit certain elements to favor a certain economic operator by losing some offers.

This error may be presented as unintentional, but in reality, a possible act of corruption may be masked. In Romania, EPPS (Electronic Public Procurement System) is the digital platform that helps reduce such "errors", although even this may have certain gaps. Although efforts have been made at the national level to promote digitalization, we encounter numerous obstacles that slow down this process.

As is the case in most areas, challenges also arise in preventing corruption risks through the use of digital tools. These include: cybersecurity can encounter gaps, public institutions can show resistance to change, digital infrastructure can require high costs, high costs for training staff in public institutions.

Regarding cybersecurity, the City Hall of Timișoara, the Local Police, and the Fiscal Directorate of this municipality were the target of a cyber attack in the summer of 2024. Workstations and servers were attacked by software created to encrypt data. The effects of this cyberattack consisted of affecting electronic public services, including the fact that the payment of fees and taxes was temporarily interrupted, and online notifications to the Local Police were suspended for a short period of time. The aim of the attack was to encrypt and block the city hall's computer system. It is a form of crime (ransomware) where the attackers then demand huge sums of money to unlock the systems.

Although the authorities initially claimed that there were no indications of the collection of personal data by the attackers, a cybersecurity expert later found out that certain data extracted from the databases of the aforementioned institutions, such as scanned diplomas or identity cards, were already being put up for sale on a Telegram channel. It was discovered that a small part of the institution's data had been compromised. Considering this, although digitalization entails numerous advantages that help reduce corruption risks, it can itself present loopholes that can even amplify the emergence of corruption risks.

In recent years, Romania has made considerable progress in terms of the digitalization of public administration, as mentioned in the reports prepared by the European Commission regarding our country. Romania has received repeated warnings because it has a slow pace in terms of implementing digital reforms. This can also be explained by the fact that there is a certain level of resistance to change in certain public institutions.

Resistance to change in public administration may also be due to the high costs of training public institution staff in the use of digital tools. Many citizens are reluctant to use digital public services for several reasons, such as: either they are used to old methods or due to lack of information.

4. Conclusions

The main advantage of digitalization is represented by the reduction of corruption risks by ensuring transparency, traceability and efficiency of the fulfillment of public acts. In addition to the fact that digitalization is currently in full expansion in public administration, the phenomenon of corruption is at a fairly high level, at least in Romania, as revealed by data published by various specialists in the field, such as those from Transparency International.

Although digitalization is often presented as an effective tool for reducing corruption risks, it is inevitably accompanied by challenges. This tool involves both benefits and risks associated with its use. By analogy, like a medicine administered by a doctor for a certain condition, it can generate adverse effects on other organs of the human body, just as digitalization contributes to increasing the transparency of administrative processes, at the same time, it can generate cyber risks for example. As can be seen from the EPPS reports, we can notice that Romania has quite a bit to catch up with before it reaches the level of Estonia in terms of digitalization of public administration.

Although this phenomenon cannot be completely eliminated, it can be kept in check with the help of an important tool - digitalization, even if using this tool requires overcoming various challenges. Public institutions should carry out campaigns to educate citizens in the digital field, to highlight the advantages of digital services and the methods of using them.

Therefore, digitalization is one of the important tools that can be used in the fight against corruption, a fight that has as implicit objectives increasing citizens' trust in public institutions, economic development, and improving public services.

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PERSPECTIVES ON THE DEVELOPMENT OF RENEWABLE ENERGY IN THE REPUBLIC OF MOLDOVA IN THE CONTEXT OF ECONOMIC SUSTAINABILITY

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Abstract: *The development of renewable energy sources has become a strategic priority for strengthening energy security and supporting economic sustainability in the Republic of Moldova. Given the country's high dependence on imported energy resources, the expansion of domestic renewable energy production is essential for reducing external vulnerabilities and improving economic resilience. This study aims to analyze the prospects for renewable energy development in the Republic of Moldova and to assess its impact on energy security and economic sustainability, with particular attention to the role of energy storage systems and regional energy hubs. The research is based on a mixed methodological approach that combines descriptive statistical analysis, energy scenario modeling for the period up to 2035, and an indicative economic evaluation of investments in renewable energy infrastructure. The results show that installed renewable electricity capacity increased rapidly, reaching approximately 950–980 MW by the end of 2025, while the share of renewable electricity in national consumption also grew significantly. At the same time, the effective use of this potential remains limited by the variability of solar and wind generation, grid constraints, and the lack of storage capacity. In response, the paper proposes a conceptual model based on three regional energy hubs integrating renewable generation, battery storage, and digital energy management systems. The findings suggest that such infrastructure could improve system flexibility, reduce energy imports, and support Moldova's long-term energy transition.*

Keywords: *renewable energy, energy security, economic sustainability, energy hubs, energy storage.*

JEL Classification: *Q42, Q48, O13.*

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1. Introduction

Energy transition is one of the most important economic and technological transformations of the last decades, driven by the need to reduce greenhouse gas emissions, enhance energy security, and develop sustainable economic models. In this context, energy from renewable sources has become a central element of energy policies at the global level, contributing to the diversification of the energy mix and the reduction of dependence on fossil fuels.

For states with a high degree of energy dependence, the development of domestic renewable energy generation capacities represents not only an energy policy option, but also a strategic necessity for strengthening economic resilience. In recent years, numerous economies have accelerated investments in clean energy technologies, smart energy infrastructure, and energy system flexibility mechanisms in order to facilitate the integration of increasingly larger volumes of renewable energy (International Renewable Energy Agency, 2023).

The Republic of Moldova has traditionally faced a high level of dependence on energy imports, which creates economic and geopolitical vulnerabilities. At the same time, the

country has significant potential for the development of renewable energy, especially in the fields of solar, wind, and biomass energy. In recent years, the renewable energy sector has experienced rapid growth, driven both by the implementation of support mechanisms for green energy producers and by the increasing investment interest in this field (Popescu & Stoica, 2024; Toma & Coretchi, 2024).

However, accelerating the development of renewable capacities also generates new challenges for the energy system. The variable production specific to solar and wind energy, together with the limitations of the existing energy infrastructure, may lead to fluctuations in energy flows within the grid and to difficulties in integrating large volumes of renewable energy. Under these conditions, the development of energy storage infrastructure and energy flexibility mechanisms becomes essential for ensuring the stability of the energy system.

In the specialized literature and in the practice of modern energy systems, energy hubs represent one of the innovative solutions for the efficient integration of decentralized renewable energy production. These infrastructures allow the aggregation of production from multiple renewable sources, the integration of energy storage systems, and the optimization of energy flows through digital energy management platforms (Geidl & Andersson, 2007; Lund et al., 2017).

In this context, the purpose of the present study is to analyze the prospects for renewable energy development in the Republic of Moldova and to assess its impact on energy security and economic sustainability. The research examines the recent evolution of renewable capacities, analyzes the challenges associated with their integration into the energy system, and proposes a conceptual model for the development of regional energy hubs aimed at increasing the efficiency of renewable energy use.

By modeling energy development scenarios through 2035, the study highlights how the integration of storage systems and energy hubs can contribute to increasing the share of renewable energy in national electricity consumption, reducing dependence on energy imports, and strengthening the economic sustainability of the Republic of Moldova.

2. Literature Review

The transition toward sustainable energy systems represents one of the most important structural transformations of the global economy in recent decades. Growing concerns about climate change, energy security, and the volatility of energy markets have led governments and international organizations to strongly promote the development of renewable energy sources, regarded as a central pillar of the energy transition and sustainable development.

The concept of sustainable development was established in economic literature through the Brundtland Report, which defines sustainable development as meeting the needs of the present generation without compromising the ability of future generations to meet their own needs (Luca, 2025; Sachs et al., 2019). This concept was later reinforced through the 2030 Agenda for Sustainable Development, which sets global objectives for sustainable economic growth and environmental protection.

In the specialized literature, energy security is defined as the capacity of an energy system to ensure the continuous and reliable supply of energy for the economy and society (Cherp & Jewell, 2014). For states with a high dependence on energy imports, the development of

renewable sources contributes to the diversification of the energy mix and to the reduction of economic and geopolitical vulnerabilities.

At the same time, numerous studies highlight the economic benefits of renewable energy, including job creation, the stimulation of technological innovation, and the reduction of external costs associated with pollution and climate change. However, the integration of renewable energy into energy systems also raises technical challenges, since solar and wind energy are characterized by high variability. In this context, the literature emphasizes the importance of developing energy flexibility infrastructures, such as storage systems and smart grids (Lund et al., 2017).

A concept increasingly analyzed in academic literature is that of energy hubs, defined as integrated infrastructures that enable the conversion, storage, and distribution of energy originating from multiple sources, while optimizing energy flows within a complex system (Geidl & Andersson, 2007). Such infrastructures facilitate the integration of decentralized renewable energy production and contribute to increasing the flexibility of energy systems (Lund et al., 2017).

In Eastern Europe, the energy transition is closely linked to the modernization of energy infrastructure and the reduction of dependence on energy imports. Analyses by the Energy Community Secretariat highlight that the development of renewable energy represents a strategic priority for the states in the region.

In the case of the Republic of Moldova, the specialized literature indicates significant potential for the development of solar, wind, and biomass energy. However, the efficient integration of these sources into the national energy system remains conditioned by the capacity of the infrastructure to manage variable production and by the existence of adequate institutional and technological solutions. In this regard, recent studies underline the relevance of strengthening the institutional framework and energy governance mechanisms in order to stimulate investment and increase the resilience of the national energy system (Toma & Coretchi, 2024).

3. Methodology

The research uses a mixed methodological approach that combines descriptive statistical analysis, energy scenario modeling, and the economic assessment of investments in renewable energy. The methodological objective of the study is to evaluate the impact of renewable energy development on the energy security and economic sustainability of the Republic of Moldova.

The analysis is based on official data from national and international institutional reports concerning the structure of the energy system, installed capacities, and electricity consumption. The main sources used include reports from the National Center for Sustainable Energy, the Ministry of Energy of the Republic of Moldova, the National Agency for Energy Regulation, and analyses on the structure of energy procurement published by Energocom. For the assessment of technological costs and global trends in the energy transition, data published by the International Renewable Energy Agency and the International Energy Agency were used. The integration of the energy system of the Republic of Moldova into the European market was analyzed on the basis of ENTSO-E documents.

The research methodology includes a descriptive analysis of the evolution of installed capacities and electricity consumption, as well as the conversion of installed capacities into annual energy production using capacity factors specific to renewable technologies. The conversion between installed capacity and annual energy produced was carried out using the following relationship:

$$E_{an}(TWh) = \frac{P_{inst}(MW) \times CF \times 8760 (hours/year)}{10^6} \quad (1)$$

where P_{inst} represents the installed capacity, and CF represents the capacity factor of the technology under analysis.

Within the scenario modeling, indicative capacity factors were used for the main renewable technologies: solar energy (0.15-0.16), wind energy (0.24-0.30), biogas (0.80-0.85), and hydropower (0.30–0.35). The research includes the modeling of three energy system development scenarios for the 2030–2035 period: a conservative scenario, an accelerated renewable energy integration scenario, and a scenario oriented toward reducing energy dependence.

The economic assessment of investments uses indicative technology costs of approximately USD 750/kW for photovoltaic installations, USD 1,200/kW for onshore wind turbines, and approximately USD 250/kWh for battery energy storage systems. The results are interpreted in the context of the macroeconomic impact of the energy transition, especially with regard to reducing energy imports and increasing economic resilience.

4. Results and Discussion

In recent years, the Republic of Moldova has recorded a significant increase in the share of electricity generated from renewable sources, marking important progress in the energy transition process. At the end of 2025, approximately 29.1% of gross final electricity consumption was covered by electricity production from renewable energy sources. This estimate was made based on electricity production data reported by distribution system operators, correlated with the data on gross final electricity consumption published monthly by the National Bureau of Statistics (CNED, 2025).

In the case of prosumers, the volume of electricity produced was estimated according to the methodology provided in the Regulation on the calculation of energy consumption from renewable sources, approved by Government Decision No. 74/2025 (Government of the Republic of Moldova, 2025). The increase in the number of prosumers, together with the development of commercial renewable energy projects, directly contributes to increasing the share of green energy in final electricity consumption. Both prosumers and commercial renewable energy producers play an important role in strengthening installed capacities and, implicitly, in enhancing the energy security of the Republic of Moldova (Ministry of Energy of the Republic of Moldova, 2025).

The positive evolution of the sector confirms progress toward the objectives set in the National Integrated Energy and Climate Plan 2025-2030, which предусматривает reaching a share of at least 27% energy from renewable sources in gross final energy consumption and 31.2% electricity from renewable sources by 2030. At the same time, these developments contribute to the reduction of greenhouse gas emissions and to the alignment of the Republic of Moldova with the objectives of the European green transition.

The dynamics of installed capacities reflect a significant acceleration of investments in the renewable energy sector. While in 2020 the installed capacity was approximately 77 MW, according to data processed by the National Center for Sustainable Energy, by the end of 2025 the total installed capacity had exceeded approximately 950–980 MW. Growth was particularly rapid in 2025, when more than 400 MW of new capacity were installed, representing around 40% of the total existing capacity and turning 2025 into a landmark year for the development of renewable energy in the Republic of Moldova.

The current structure of renewable capacities is dominated by photovoltaic energy, which accounts for approximately 70-72% of the total installed capacity, followed by wind energy, with approximately 25-27%, while the remainder is represented by biomass installations and small hydropower plants. Most of these capacities have been developed in the form of small- and medium-sized energy parks, directly connected to the distribution networks of energy operators. Under this operational model, the electricity produced is injected directly into the grid and transmitted to consumers through the existing energy infrastructure (National Center for Sustainable Energy, 2025; Energy Community Secretariat, 2024).

Annual Evolution of Installed RES Capacities

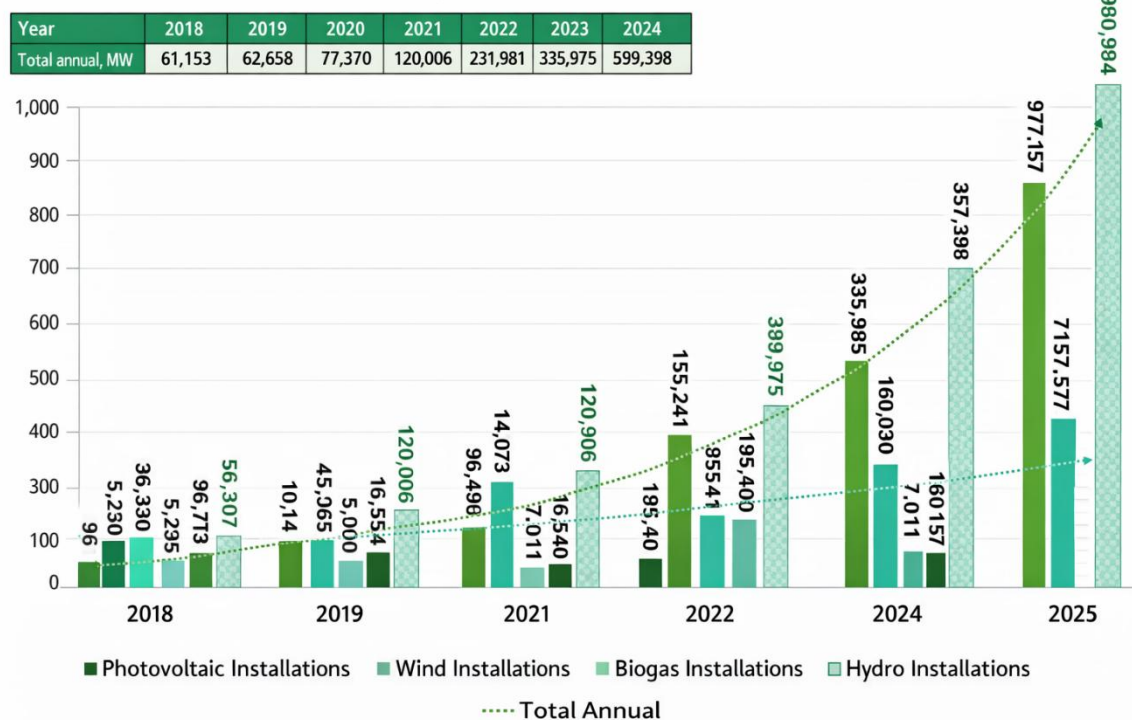


Fig. 1. Annual evolution of installed renewable energy capacities

Source: elaborated by the authors based on the National Center for Sustainable Energy (2025), <https://cned.gov.md/ro/content/capacitati-instalate> and the National Agency for Energy Regulation (2025), <https://anre.md>.

Under these conditions, renewable energy covers approximately 28% of national electricity consumption. However, the current energy system faces several important structural limitations:

- lack of energy storage infrastructure;
- variability in solar and wind energy production;

- grid constraints during periods of high production.

As a result, part of the renewable energy produced cannot be used efficiently.

During periods when local production exceeds domestic consumption, surplus energy is injected into the electricity grid. Consequently, the energy system is becoming increasingly decentralized, being supplied simultaneously by hundreds of energy parks and thousands of small-scale photovoltaic installations.

Although this model allows for the rapid integration of renewable energy into the energy system, the accelerated and dispersed development of renewable capacities generates a series of technical and economic challenges. First, solar and wind energy production is characterized by a high degree of variability, determined by weather conditions. This variability can lead to significant fluctuations in energy flows within the grid, especially during periods when renewable energy production exceeds instantaneous system demand.

Secondly, electricity distribution and transmission networks were not originally designed to handle large volumes of decentralized generation. In the context of the rapid growth of renewable capacities and the expansion of prosumers, this situation may lead to congestion in energy infrastructure and limit the system's capacity to integrate new energy projects (Energy Community Secretariat, 2024; International Energy Agency, 2023).

In theory, each renewable energy park or even each prosumer could integrate its own energy storage systems in order to reduce the impact of production variability. However, such an approach would lead to the fragmentation of energy infrastructure and to an increase in total system costs, since the installation of individual storage systems for each facility does not allow the benefits of economies of scale to be fully realized.

In this context, the development of regional energy hubs may represent an efficient solution for the coordinated integration of renewable energy production. Through these hubs, surplus energy generated in certain areas or periods, including energy produced by households or renewable energy parks, can be directed to centralized storage systems or redistributed to other areas of the network where there is a production deficit.

In this way, energy hubs can function as balancing and flexibility mechanisms for the energy system, reducing grid fluctuations and facilitating the integration of additional renewable energy capacities.

The integration of prosumers into these regional energy platforms transforms decentralized production into a collective resource of energy flexibility, allowing the aggregation of production from thousands of small installations. At the same time, the centralization of storage and energy management functions at the hub level enables the reduction of investment costs and increases the economic efficiency of the energy system (International Energy Agency, 2023; International Renewable Energy Agency, 2023; Lund et al., 2017).

Therefore, energy hubs would not replace the existing energy infrastructure, but would function as regional platforms for integrating decentralized energy production, connecting renewable energy parks, prosumers, and storage systems within a coordinated mechanism for managing energy flows. In the context of the accelerated development of renewable energy in the Republic of Moldova, the implementation of such energy hubs could represent an essential element for strengthening energy security and creating a more flexible, efficient, and sustainable energy system (Geidl & Andersson, 2007; Lund et al., 2017).

To better understand their role in modern energy systems, an energy hub can be defined as an integrated energy infrastructure that connects multiple renewable energy generation facilities with storage systems, digital energy management systems, and electricity transmission infrastructure. The main purpose of the hub is to optimize the production, storage, and distribution of energy within an energy system characterized by a high share of renewable sources.

Within the energy hub, the energy flow can be described through the following functional structure:

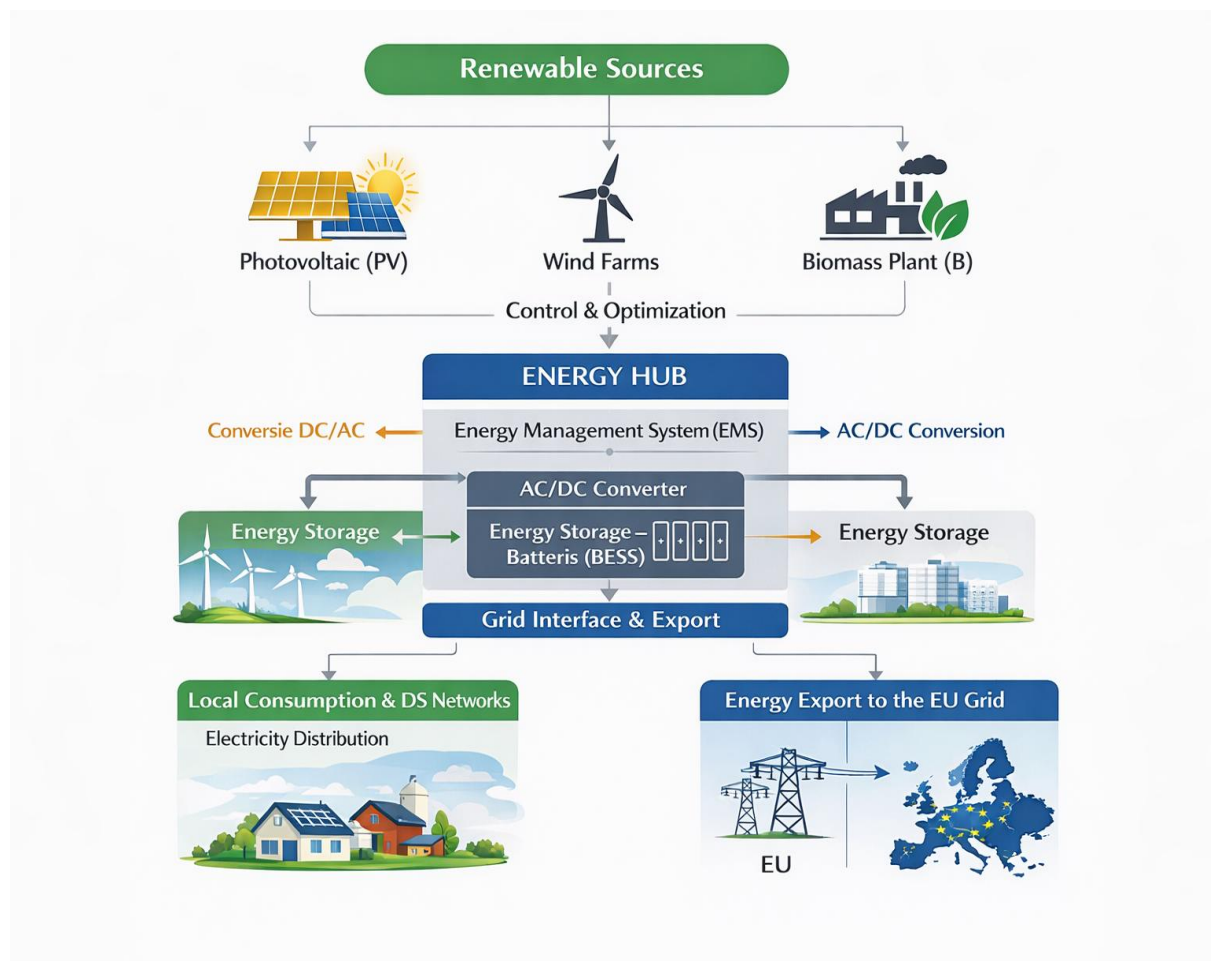


Fig. 2. Annual evolution of installed renewable energy capacities

Source: elaborated by the authors based on Geidl & Andersson (2007) and Lund et al. (2017)

To increase the efficiency of renewable energy utilization, the study proposes the implementation of regional energy hubs that integrate existing and future renewable production into a coordinated energy system.

The energy hub represents a regional energy node that performs multiple functions:

- aggregation of renewable production from multiple energy parks;
- storage of energy in large-capacity batteries;
- optimization of energy flows through digital management systems;

- delivery of energy to the grid during periods of high demand.

The system is coordinated by an Energy Management System (EMS), which monitors production and consumption and optimizes energy flows in real time. For the Republic of Moldova, the development of three regional energy hubs is proposed.

Table 1. Conceptual model for the distribution of regional energy hubs

Energy Hub	Integrated Capacity
North Hub	~300 MW
Central Hub	~350 MW
South Hub	~300 MW
Total	~950 MW

Source: elaborated by the authors based on the National Center for Sustainable Energy (2025), <https://cned.gov.md/ro/content/capacitati-instalate>, and the National Agency for Energy Regulation (2025), <https://anre.md>.

These hubs do not imply building all capacities from scratch, but rather integrating the existing capacities into a coordinated energy infrastructure. Annual electricity production can be estimated using the following relationship:

$$E = P \times CF \times 8760 \quad (2)$$

where:

- E represents the annual energy produced (MWh);
- P represents the installed capacity (MW);
- CF represents the capacity factor;
- 8760 represents the number of hours in a year.

For each technology, the following average capacity factors can be used:

Table 2. Estimation of annual energy production

Technology	Capacity	Capacity Factor	Annual Production
Solar	650 MW	0.15	~854 GWh
Wind	250 MW	0.28	~613 GWh
Biomass	40 MW	0.80	~280 GWh
Hydro	10 MW	0.30	~26 GWh
Total	950 MW		~1.77 TWh

Source: elaborated by the authors based on the National Center for Sustainable Energy (2025), <https://cned.gov.md/ro/content/capacitati-instalate> and the International Energy Agency (2022), <https://www.iea.org/reports/world-energy-outlook-2022>

At present, not all of this energy can be used efficiently, and it is estimated that approximately 10-12% of renewable energy is lost due to the limitations of the electricity grid (Energy Community Secretariat, 2024; International Renewable Energy Agency, 2023).

An essential role in the functioning of the energy hub is played by Battery Energy Storage Systems (BESS), which allow the absorption of surplus energy produced during periods of high generation and its delivery during periods of increased demand. In energy systems with

a high share of renewable energy, storage becomes a fundamental element for maintaining the stability of the electricity grid.

The optimal storage capacity can be estimated using the relationship: $BESS = \alpha \times P_{SER}$ where P_{SER} represents the total installed capacity from renewable sources connected to the hub, and α represents the storage sizing coefficient, typically ranging between 0.25 and 0.40 in energy systems with a high share of solar and wind energy (International Renewable Energy Agency, 2022).

Thus, for an energy hub that integrates approximately 950 MW of renewable capacities, the optimal storage capacity can be estimated as follows:

$$BESS = 0,3 \times 950 = 285 \text{ MWh} \quad (3)$$

This level of storage would allow the absorption of surplus energy produced during peak solar generation hours and would contribute to stabilizing energy flows within the electricity grid. The results show that energy hubs could increase the share of renewable energy by approximately 3 percentage points under current conditions.

In the analyzed development scenario, installed renewable capacity could increase by approximately 700 MW, reaching around 1,650 MW by 2035.

Table 3. Scenarios for the integration of renewable energy and storage systems in the Republic of Moldova

Indicator	2025 Current System	2025 with Energy Hub	2035 without Hub (1650 MW)	2035 with Energy Hub
Installed renewable capacity	~950 MW	~950 MW	~1650 MW	~1650 MW
Storage capacity	~0 MWh	~285 MWh	~0 MWh	~495 MWh
Storage investment (BESS)	—	≈85 mil €	—	≈150 mil €
Theoretical renewable production	~1.77 TWh	~1.77 TWh	~3.0 TWh	~3.0 TWh
Effectively used energy	~1.55 TWh	~1.72 TWh	~2.60 TWh	~3.00 TWh
Lost energy (curtailment)	~0.22 TWh	~0.05 TWh	~0.40 TWh	~0.05 TWh
National energy consumption	~4.5 TWh	~4.5 TWh	~4.5 TWh	~4.5 TWh
Renewable share	~28 %	~31 %	~58 %	~66 %
Savings from reduced imports	—	~8–9 mil € / year	—	~15–18 mil € / year
Estimated payback period	—	≈11–12 years	—	≈8–9 years

Source: elaborated by the authors based on the National Center for Sustainable Energy (2025), <https://cned.gov.md/ro/content/capacitati-instalate>; the National Agency for Energy Regulation (2025), <https://anre.md>; BloombergNEF (2024), <https://about.bnef.com>; the International Energy Agency (2022, 2023), <https://www.iea.org>; and the International Renewable Energy Agency (2022, 2023), <https://www.irena.org>.

The comparative analysis highlights that the implementation of energy hubs can significantly contribute to increasing the efficiency of renewable energy utilization within the energy system of the Republic of Moldova.

Under current conditions, although installed renewable energy capacity exceeds approximately 950 MW, part of the energy produced cannot be fully utilized due to the limitations of the energy infrastructure and the absence of storage systems. In this context, renewable energy covers approximately 28% of national electricity consumption.

The integration of these capacities into regional energy hubs, equipped with storage systems with a capacity of approximately 285 MWh, would allow the recovery of a significant share of the lost energy and could increase the share of renewable energy to approximately 31% of national electricity consumption.

The impact of this infrastructure becomes much more pronounced in the development scenario projected for 2035. If installed renewable capacity increases by approximately 700 MW, reaching around 1,650 MW, annual renewable energy production could exceed 3 TWh.

In the absence of storage infrastructure and energy hubs, approximately 10–15% of this energy could be curtailed or lost due to grid constraints and the variability specific to solar and wind sources. Under these conditions, the effectively utilized production would be approximately 2.6 TWh, which would represent around 58% of national electricity consumption.

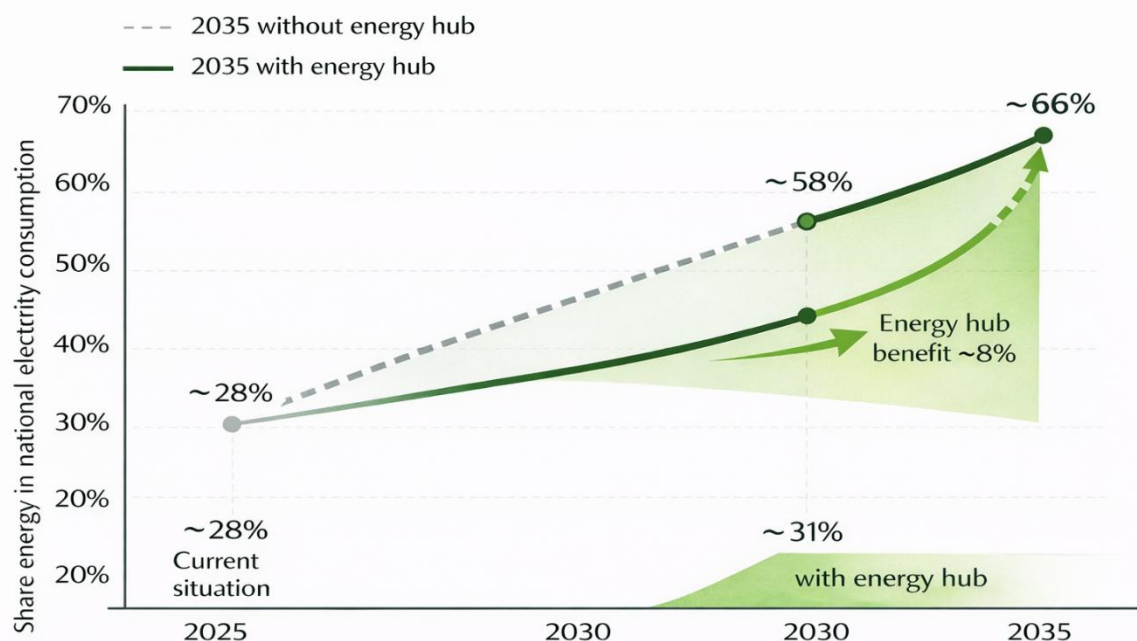


Fig. 3. Estimated share of renewable energy in national electricity consumption under the scenarios with and without an energy hub, 2025-2035.

Source: elaborated by the authors based on the National Center for Sustainable Energy (2025), <https://cned.gov.md/ro/content/capacitati-instalate>; the National Agency for Energy Regulation (2025), <https://anre.md>; BloombergNEF (2024), <https://about.bnef.com>; the International Energy Agency (2022, 2023), <https://www.iea.org>; and the International Renewable Energy Agency (2022, 2023), <https://www.irena.org>.

By implementing energy hubs and storage systems with an estimated capacity of approximately 495 MWh, nearly the entire amount of renewable energy produced could be

utilized. In this scenario, the share of renewable energy in the national energy mix could reach approximately 66%, representing an increase of about 8 percentage points compared to the scenario without energy hubs, and would significantly contribute to reducing the Republic of Moldova's dependence on electricity imports.

From an economic perspective, the implementation of energy hubs mainly involves investments in energy storage systems and digital energy management infrastructure. The average cost of utility-scale storage systems is currently estimated at approximately EUR 250-350/kWh (BloombergNEF, 2024; International Renewable Energy Agency, 2022).

In the current scenario, for a storage capacity of approximately 285 MWh, the total investment could be estimated at EUR 85 million. To this value are added the costs of energy management systems (EMS), grid integration, and energy hub infrastructure, leading to a total estimated investment of approximately EUR 90-110 million for the implementation of three regional energy hubs.

In the development scenario through 2035, storage capacity would need to be expanded to approximately 495 MWh. The total investment could reach approximately EUR 150 million. The economic benefits are generated primarily by the reduction of electricity imports. The additional energy utilized through the use of storage is estimated at approximately 170 GWh annually under current conditions.

The results indicate that investments in energy hubs and storage systems can be recovered within a relatively moderate period. In the current scenario, the savings generated through the reduction of electricity imports may exceed EUR 8-9 million annually, leading to an estimated payback period of approximately 11-12 years.

In the development scenario through 2035, the increase in renewable capacity and in the volume of utilized energy may generate savings of EUR 15–18 million annually, reducing the investment payback period to approximately 8-9 years.

Compared with the current model, in which each renewable energy park injects electricity directly into the grid, energy hubs offer several systemic advantages.

Table 4. Comparative characteristics of the current model and the energy hub model in the integration of renewable sources

Current model	Energy hub model
Dispersed parks	Aggregated production
No regional coordination	Centralized energy management
Limited storage	Integrated storage
Large grid fluctuations	Local energy balancing
Fragmented costs	Economies of scale

Source: elaborated by the authors based on Geidl & Andersson (2007), Lund et al. (2017), the International Renewable Energy Agency (2022), <https://www.irena.org>, and the International Energy Agency (2023), <https://www.iea.org>.

By aggregating renewable energy production into a regional energy node, the energy hub can reduce production variability and optimize the use of energy infrastructure (Geidl & Andersson, 2007).

The analysis presented demonstrates that the development of a regional energy hub is feasible from both a technical and an economic perspective. The integration of existing renewable capacities into a coordinated energy system can increase the efficiency of energy infrastructure and reduce the costs associated with the integration of renewable energy.

At the same time, the implementation of such energy hubs could contribute to strengthening the energy security of the Republic of Moldova by reducing dependence on energy imports and increasing the share of renewable energy in the national energy mix.

In the long term, the development of regional energy hubs could transform the Republic of Moldova into a regional energy node connected to the European energy market, facilitating both the integration of renewable energy into the national energy system and the export of energy to regional markets (Energy Community Secretariat, 2024; Ministry of Energy of the Republic of Moldova, 2025).

5. Conclusions

The analysis carried out confirms that the development of renewable energy sources represents an essential strategic element for strengthening energy security and promoting economic sustainability in the Republic of Moldova. The accelerated pace of investments in renewable capacities in recent years reflects both investors' interest in the green energy sector and the country's significant potential to capitalize on solar and wind resources.

The research results highlight that the efficient integration of renewable energy depends to a large extent on the modernization of energy infrastructure and the development of energy system flexibility mechanisms. In this context, regional energy hubs, integrated with storage systems and digital energy management platforms, can contribute to optimizing energy flows, reducing energy losses, and increasing the share of renewable energy in the national energy mix.

The modeling of development scenarios shows that, through the implementation of such infrastructures, renewable energy could become a dominant component of the national energy system over the next decade. At the same time, the economic analysis indicates that investments in energy hubs and storage systems are feasible and can generate significant economic benefits by reducing electricity imports and increasing the efficiency of the use of domestic energy resources (BloombergNEF, 2024; International Renewable Energy Agency, 2022, 2023).

An important aspect highlighted by the study is the recent dynamics of investments in renewable capacities. The installation of approximately 400 MW of new capacity in a single year indicates the existence of strong potential for accelerated sectoral development. If this trend continues over the next decade, installed renewable capacity could significantly exceed the levels analyzed in the study's moderate scenarios. Under these conditions, annual renewable energy production could exceed the domestic electricity consumption of the Republic of Moldova.

Therefore, in the context of the development of storage infrastructure, the implementation of regional energy hubs, and the integration of the national energy system into the European energy market, the Republic of Moldova could achieve a high level of energy independence and even exceed the threshold of 100% renewable energy relative to domestic consumption. In such a scenario, surplus energy could be utilized through exports to regional markets, contributing both to the strengthening of energy security and to long-term economic development.

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