

THE ROLE OF DIGITAL TECHNOLOGY IN THE DEVELOPMENT OF ENTERPRISES IN THE EUROPEAN UNION

Marina COBAN¹

Abstract: *The adoption of digital technologies by EU businesses enables them to achieve better performance in terms of productivity, management practices, innovation and has a major impact on the economic growth of European countries. The aim of the paper is the analysis of digital transformation of enterprises in the EU states. We used comparative analysis of existing data from the Eurostat database. Several indicators are analyzed in this paper, such as the degree of digital intensity, the use of Cloud computing, Big data, Artificial intelligence, the share of SMEs that sell online and sell online cross-border in various EU countries. The advantages and disadvantages of e-commerce as well as the problems faced by SMEs in selling online cross-border, such as problems related to returning products, solving complaints and disputes, lack of knowledge of foreign languages were highlighted. Our study provides an overview of the current state of adoption of digital technologies by EU businesses and identifies the main trends of digital technologies progress in different EU countries.*

Keywords: *digital technology, digital transformation, Cloud computing, Big data, Artificial intelligence, e-Commerce*

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Introduction

The use of digital technologies by enterprises allows to obtain better performances in terms of productivity, management practices, innovation. The digital transformation of the European Union countries is important for recovery, prosperity, security, competitiveness and the well-being of societies. This transformation is also essential for achieving the transition to a climate-neutral, circular and resilient economy. The EU's objective is to be digitally sovereign and to implement digital policies that enable citizens and businesses to benefit from a sustainable and more prosperous digital future.

In this regard, the present research has established the goal to analyze Digital technology indicators and Digital Intensity Index in large and SMEs in the EU countries.

Business digitalization involves connecting digital technologies to improve business processes, increase enterprise productivity and customer loyalty. Thanks to the use of digital technologies, companies can satisfy customer requests faster, simplify communication between business and client, automate communications within the company, reduce labor costs, gain competitive advantages, improve services and products and have the opportunity to expand their markets.

¹ Marina COBAN, associate professor, Academy of Economic Studies of Moldova, Republic of Moldova, mcoban.mcoban@gmail.com, [ORCID:0009-0005-1984-9682](https://orcid.org/0009-0005-1984-9682)

In the present paper it is analyzed the situation in the field of digital transformation of enterprises in the EU states. Several indicators are analyzed, such as the degree of digital intensity, the use of Cloud computing, Big data, Artificial intelligence and the share of businesses that sell online.

The paper includes a literature review in the sphere of digital economy, the comparative analysis of the indicators was carried out based on Eurostat databases, the share of small and large enterprises in EU countries that have adopted digital technologies.

Afterwards, the present research provides several recommendations for increasing the degree of digitization of enterprises.

1. Literature review

In order to have a better understanding of the issues related to the use of digital technologies by enterprises in European countries a subset of the relevant literature was selected. Accordingly, *Shaping Europe's Digital Future* (2020, p.3) businesses need a framework that allows them to start up, scale up, pool and use data, to innovate and compete or cooperate on fair terms. And Europe needs to have a choice and pursue the digital transformation in its own way.

According to *2030 Digital Compass: the European way for the Digital Decade* (2021, p.2) digital technologies are now imperative for working, learning, entertaining, socialising, shopping and accessing everything. Using digital technologies, Europe can be digitally sovereign and can take advantage of digital transformations. Digitalization allows entrepreneurs to innovate, set up and grow their business wherever they live, opening markets and facilitating investments across Europe and globally, and creating new jobs.

The role of Digital Technology in the Development of the Enterprises has been discussed by many authors in their literature. A number of studies (Verhoef, P.C. *et al*, 2021, p.890) show that the use of digital technologies changes the business model of companies having organizational implications. Digital technologies help to create and appropriate more value for the firm (Kane, Palmer, Philips, Kiron, & Buckley, 2015, p.5).

Some authors (Parviainen, P., *et al*, 2017, p.63) mentioned that digitalization has been identified as one of the major trends changing business. The transition from the analogue economy to digital economy will lead to the changes in the structure of the economy and business model. (Oh D.H., Danilchanka A., Zhalezka B., Siniauskaya V., 2021, p.114). The digitalization is one of the most important provocations associated with the process of Industrialization 4.0 (Dorogaia, I., 2022, p.57). Digitalization causes changes for companies due to the adoption of digital technologies in the organization.

The global study of digital business (Kane, *et al*, 2015, p.3) found that maturing digital businesses are focused on integrating digital technologies, such as social, mobile, analytics and cloud. Less-mature digital businesses are focused on solving business problems with individual digital technologies.

Cloud computing essentially allows an enterprise to easily access IT resources anywhere and anytime with minimal need for control or oversight. Tanweer A., (2020, p.108) highlighted that Cloud computing has been considered as one of the best computing paradigms in the field of information technology in recent years.

In the modern business environment, the amount of information is growing rapidly in all areas of activity of the society. Big data, that is considered a key driver of marketing and innovation processes, allows to analyze these huge data sets and effectively use the results of this analysis in forecasting and making the right management decisions. Some authors Loebbecke, C., & Picot, A. (2015, p.149) highlighted that digitization and big data analytics reshape business models and impact employment.

Artificial intelligence — one of the newest technologies that permeates all business spheres. It helps companies improve customer service, process incoming calls, effectively use marketing tools, analyze competitors, etc. Its use by manufacturing enterprises allows solving complex tasks to increase productivity, lower costs and increase overall efficiency.

Big data, artificial intelligence (AI), blockchain and robotics will have major effects on business (Chen, Chiang, & Storey, 2012, P.1165; Ng & Wakenshaw, 2017, p.3).

The beginning of the 21st century is characterized by the rapid development of digital technologies. There are several business processes in which digital technologies are being introduced: product quality; the term of bringing the product to the market; production efficiency; logistics.

Thanks to the literature examined, the following idea can be pinpointed that only those enterprises that are equipped with digital technologies and are interested in digital interaction will eventually turn out to be the most capacious and profitable, demonstrating rapid development in a permanently changing global environment.

2. Research methodology

This paper is based on the analysis of the statistical data provided by Eurostat, on the examination of the strategies and policies developed by the European Commission on digitalization issues. To carry out the study, we used such scientific research methods as analysis and synthesis, which allowed us to present the essence of the studied theme, to highlight the advantages, benefits, challenges of the digital transformations of enterprises, to show the methods of solving different complex problems.

To compare the indicators related to digital technologies, we have used bar graphs, which allowed to visually represent data, to analyze, to identify differences among different EU countries and to interpret information in a concise way.

Systemic analysis and comparative analysis gave us the opportunity to compare the degree of digitization of enterprises in different EU states using such indicators as electronic sharing of information, use of social networks, use of more advanced technologies such as big data analysis, cloud services and artificial intelligence. Following

the research carried out, relevant conclusions were made and practical suggestions were offered that could help businesses take advantage of the benefits offered by digitization.

3. Findings

EU enterprises' use of digital technology is expressed through the Digital Economy and Society Index (DESI).

The digitalization of business includes the electronic sharing of information, the use of social networks, the use of the most advanced technologies such as big data analysis, cloud services and artificial intelligence (AI).

Businesses are increasingly digitalized, but the use of advanced digital technologies remains low. Although already 33,99% of EU enterprises are based on cloud computing (in 2022), only 7,91 % used AI (in 2022) and 14,22 % big data (in 2022).

Support measures amounting to EUR 24 billion are planned for the digitization of business and EUR 18 billion for research and development in the digital field. The largest investments in this area are offered by Italy, Spain, Germany and Greece.

Table 1 shows the values of this indicator for the 2021 year.

Table 1. Digital technology indicators in EU enterprises

Nº	Digital technology indicator	2022
1	SMEs with at least a basic level of digital intensity, % SMEs	54,86%
2	Electronic information sharing, % enterprises	38,09
3	Social media, % enterprises	29,34
4	Big data, % enterprises	14,22
5	Cloud, % enterprises	33,99
6	AI, % enterprises	7,91
7	ICT for environmental sustainability, % enterprises	65,89
8	e-Invoices, % enterprises	32,17
9	SMEs selling online, % SMEs	18,47
10	e-Commerce turnover, % SME turnover	11,64
11	Selling online cross-border, % SMEs	8,73

Source: DESI 2022

As we can see from table 1 in 2022, 54,85 % of SMEs used digital technologies, at least at the basic level of digital intensity. The largest share, 65,89 % of enterprises, use ICT for environmental sustainability. Electronic information is used by 38,09 % of enterprises, Cloud computing – 33,99 %, e-Invoices -32,17 %, social media by 29,34 % of enterprises. The use of other technologies is still at a low level. Thus, only 14,22 % of enterprises use Big data and 7,91 % AI.

According to Eurostat data, the best performers in the integration of digital technologies are Finland (59%), Denmark (58%) and Sweden (57%). Romania (15%), Bulgaria (16%) and Hungary (21%) show the worst performances.

According to the objective proposed in the Path to the Digital Decade, by 2030 more than 90% of SMEs should reach at least a basic level of digital intensity, 75% of EU companies should use cloud, AI and Big data.

To measure the use of different digital technologies at enterprise level it is used digital intensity index (DII). This index shows how many technologies out of 12 are used by the enterprise.

The basic DII level involves the use of at least four digital technologies. According to this criterion, SMEs with very high, high and low DII are distinguished.

Only in a few EU countries, such as Finland, Denmark, Malta and Sweden, the DII is very high, over 90%, which means that out of the 12 digital technologies monitored at least 10 are used. In these countries the share of enterprises with high DII is at least 80%. In Austria, Ireland, Slovenia and Germany this DII constitutes over 40%. Other countries such as Romania, Bulgaria, Hungary, Greece and Latvia have a very low DII, indicating the use of digital technologies by businesses in these countries in the range of 0-3 of the 12 technologies monitored. In Romania, Bulgaria, the share of enterprises with a basic level of digital intensity is less than 30%.

Table 2 shows the composition of the DII in 2021 and the degree of adoption of different technologies monitored by the DII. Large companies in the EU are more digitized than SMEs, but they still have reserves for increasing the indicators.

Table 2. Digital Intensity Index indicators tracking digitization processes (% enterprises), 2021

No	Digital Intensity Index indicators	Large	SMEs
1.	The maximum contracted download speed of the fastest fixed line internet connection is at least 30 Mb/s	95%	80%
2.	Use of any social media	83%	58%
3.	Enterprises where more than 50% of the persons employed used computers with access to the internet for business purposes	58%	49%
4.	Use of any cloud service	72%	40%
5.	Have software enterprise resource planning (ERP) package to share information between different functional areas	81%	37%
6.	Have customer relationship management (CRM)	65%	34%
7.	Buy intermediate-sophisticated cloud computing (CC) services	60%	33%
8.	Use of at least 2 social media	61%	28%
9.	Use any Internet of Things (IoT)	48%	28%
10.	Enterprises with e-commerce sales of at least 1% turnover	38%	18%
11.	Enterprises where web sales are more than 1% of the total turnover and B2C web sales more than 10% of the web sales	12%	11%
12.	Use any AI technology	28%	7%

Source: Eurostat, European Union survey on ICT usage and e-commerce in enterprises

Large enterprises are adopting digital technologies largely. Figure 1 shows the data on the adoption of digital technologies by small and medium-sized enterprises in 2020 and 2021.

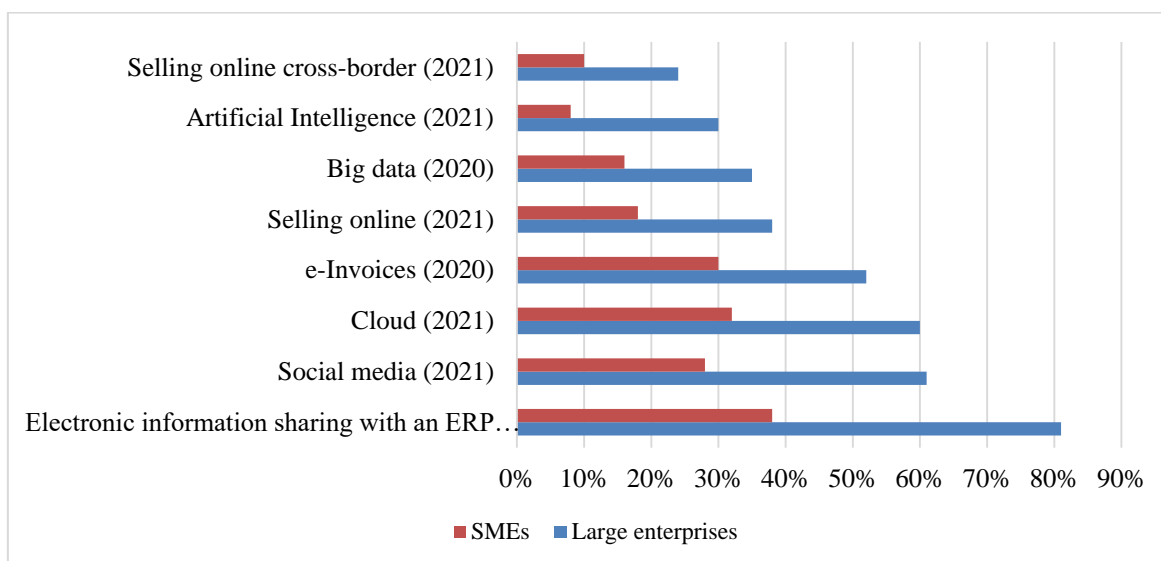


Figure 1. Adoption of digital technologies (% enterprises), 2020, 2021

Source: Eurostat, European Union survey on ICT usage and e-commerce in enterprises

As we can see from figure 1, the percentage of large enterprises that use electronic information sharing through enterprise resource planning software (ERP) constitutes 81% while for SMEs it constitutes 37%. The share of companies using social media is 61%, while SMEs only 28%. Among large companies, 38% sell online and only 18% for SMEs. SMEs are lagging behind enterprises in the use of cloud, AI and big data.

Cloud computing is a model for providing enterprises access to computing resources, including servers, databases, software applications, storage capacity and computing power. Instead of building their own IT infrastructure enterprises can access computing resources hosted by third parties on the internet (the ‘cloud’).

The Path to the Digital Decade sets requirements that over 75% of EU enterprises adopt cloud computing until 2030. According to Eurostat data in 2021 34% of EU enterprises purchased sophisticated or intermediate cloud computing services for finances/accounting, for managing information about their customers (customer relationship management – CRM) and for planning their processes and resources (enterprise resource planning - ERP). Moreover, 24% reported using cloud computing platforms for computing power in order to run their own business software applications. One of five enterprises (21%) bought cloud computing services for testing, application implementation or development. In 2021 cloud uptake by large companies was 60% and by SMEs 33%. Figure 2 shows the data regarding share of enterprises per country using cloud computing services.

It can be observed that there are significant differences across countries. In Sweden (69%), Finland (66%), Denmark (62%) and the Netherlands (60%) at least 60% of enterprises used cloud computing. On the other hand, in Greece (17%), Romania (11%) and Bulgaria (10%) less than 25% of enterprises did so.

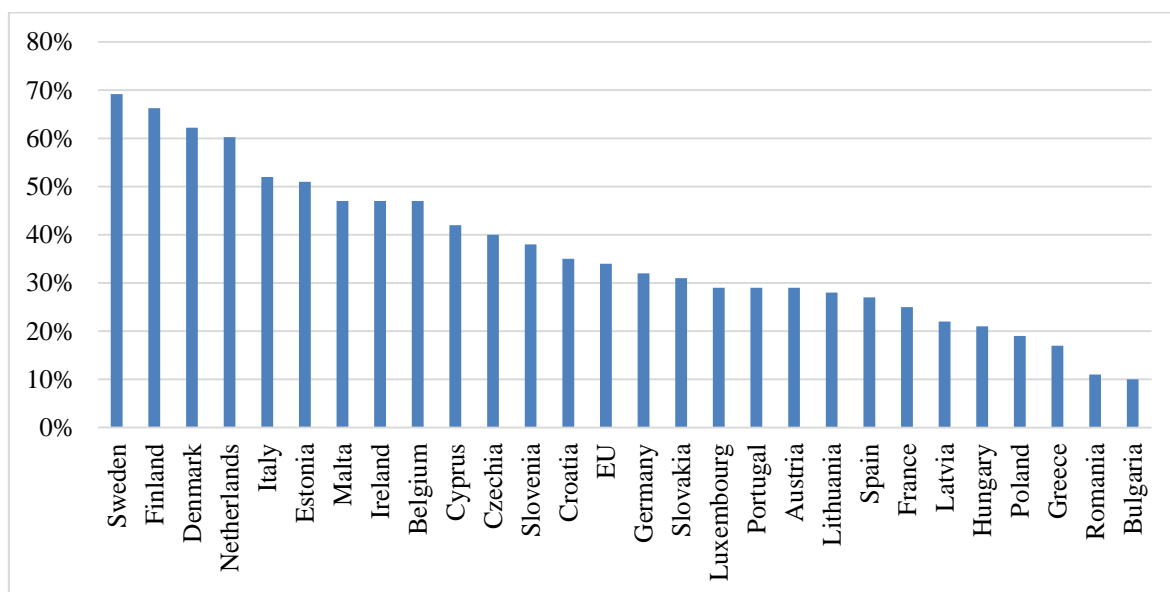


Figure 2. Cloud computing services of sophisticated or intermediate level per country (% of enterprises), 2022

Source: Eurostat, European Union survey on ICT usage and e-commerce in enterprises

The analysis of cloud computing services usage by sector showed that 66% of enterprises in the ICT sector use these services at sophisticated or intermediate level, followed by publishing activities; motion picture, video and television program production, sound recording and music publishing, programming and broadcasting (60%); travel agency/tour operator reservation service and related activities (48%), real estate activities (41%); accommodation (36%); electricity, gas, steam, air conditioning and water supply (35%); wholesale and retail trade; repair of motor vehicles and motorcycles (33%), manufacturing (32%); transportation and storage (29% of enterprises). The sector with the least cloud usage is the construction sector (26% of enterprises).

The Path to the Digital Decade sets requirements that over than 75% of EU companies adopt big data by 2030. Big data is larger, more complex sets of data that are so large that traditional data processing software cannot manage them, but they can be used to solve business problems that were previously impossible have been able to tackle before.

Big data are characterized by volume, variety and velocity. With big data, there are possibilities to process high volumes of unstructured data. Variety refers to many types of data that are available. Traditional data types were structured. With the rise of big data, data comes in new unstructured data types. Unstructured data types, such as text, audio, and video, require additional preprocessing to derive meaning and support metadata.

Big Data can help to range business activities such as:

- *product development*- enterprises use data and analytics from focus groups, social media, market tests to plan, produce and launch new products;
- *predictive maintenance* - by analyzing some indications of potential issues before the problems have happened, organizations can deploy maintenance more cost effectively and maximize parts and equipment uptime;

- *customer experience* - Big data enable to gather data from social media, web visits, call logs, and other sources to improve the interaction experience and maximize the value delivered;
- *fraud and compliance* - Big data help to identify patterns in data that indicate fraud and aggregate large volumes of information to make regulatory reporting much faster;
- *machine learning* - availability of big data allows to train machine learning models;
- *operational efficiency* - with big data, there is the possibility to analyze and assess production, customer feedback and returns, and other factors to reduce outages and anticipate future demands.
- *drive innovation* - Big data can help to innovate by studying interdependencies among humans, institutions, and process and then determining new ways to use those insights.

Big Data have some benefits:

- Big data make it possible to gain more complete answers because there is more information.
- more complete answers means a completely different approach to tackling problems.

According to Eurostat data, in 2021 34% of large enterprises used big data, and only 14% of SMEs used big data.

Analysis of Big data usage by sector showed that enterprises are more likely to analyze big data in the travel agency, tour operator reservation service and related activities and in publishing activities sectors (both at 28%), followed by the ICT (25%); transportation and storage (22% of enterprises); electricity, gas, steam, air conditioning and water supply (20%); accommodation (17%); wholesale and retail trade; repair of motor vehicles and motorcycles (15%); construction(13%); real estate activities (13%); manufacturing (10%).

The analysis of the share of enterprises analyzing Big data is presented in figure 3.

According to the data in figure 3, in Malta almost 30% of enterprises analyze big data, followed by the Netherlands and Denmark with 27%. Only 5-6% of enterprises in Romania, Slovakia, Cyprus and Bulgaria analyze big data.

The Path to the Digital Decade target requires that more than 75% of EU companies adopt AI technologies by 2030.

The application of artificial intelligence in the enterprise changes the way of business work. There are applications for enterprises based on AI to enhance customer service, maximize sales, assure cyber-security, optimize supply chains, free up workers from some tasks, improve existing products and develop new products.

Enterprise leaders determined the use of AI to face big challenges. The domain of artificial intelligence is changing rapidly because of the enormous amount of AI research being done. There are a multitude of AI use cases. Investment in AI-enabled hardware and software robotics is expected to rise.

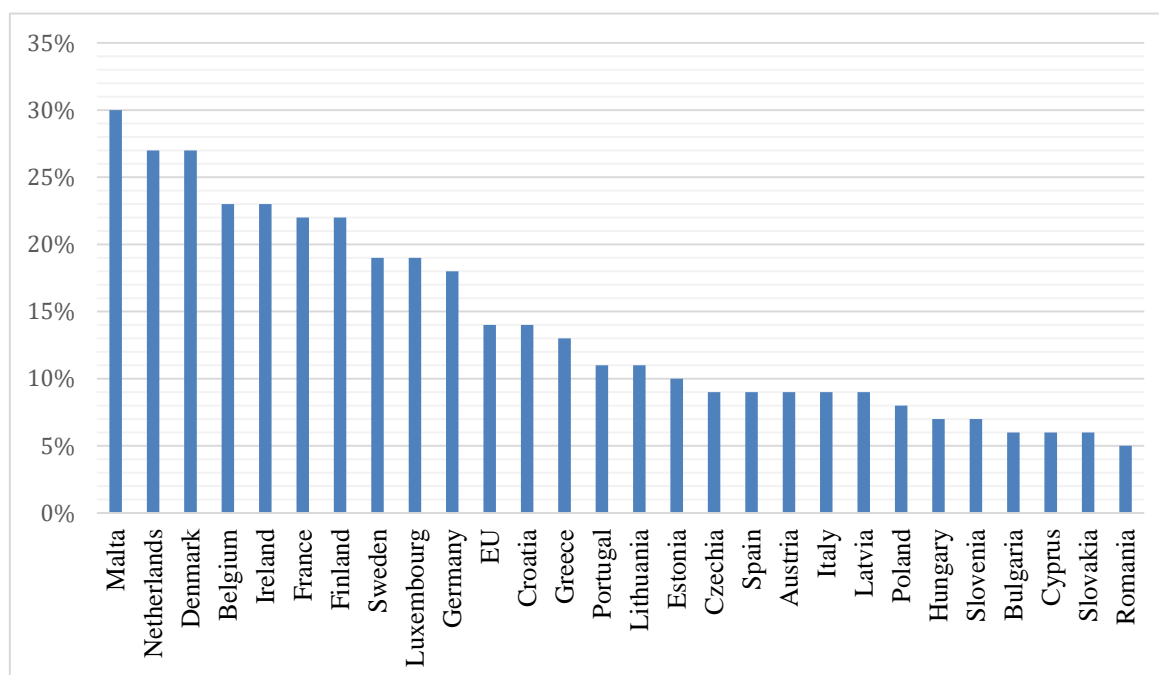


Figure 3. Enterprises analyzing big data (% of enterprises), 2022

Source: Eurostat, European Union survey on ICT usage and e-commerce in enterprises

Business leaders must understand how AI works, where AI technologies can be used by businesses and where they cannot. It is important to know all benefits and risks:

- current and potential AI use cases;
- how to elaborate a successful AI strategy;
- the necessary steps for implementing AI tools in the enterprise.

The analysis of the share of enterprises using an AI technology is presented in figure 4.

According to the data in figure 4, the adoption of AI technologies in European Union countries is quite low, at 8%. However, there are some differences between Member States. Some countries have an adoption rate of AI technologies above 10%. Among them there are Denmark (24%), Portugal (17%), Finland (16%), the Netherlands (13%), Luxembourg (13%), Slovenia (12%), Germany (11%), Belgium (10%), Malta (10%), Sweden (10%).

There are seven countries with an adoption rate between 5 and 10%, such as Austria (9%), Croatia (8%), Ireland (8%), Spain (8%), France (7%), Italy (6%), Slovakia (5%).

Another 10 countries have a very low adoption rate of up to 5%, for example Czechia (4%), Lithuania (4%), Greece (4%), Latvia (4%), Bulgaria (3%), Hungary (3%), Poland (3%), Estonia (3%), Cyprus (3%).

Romania has the lowest absorption of AI in the EU, 1%. This situation is due to the very low level of digitization of enterprises in Romania. Basic technologies are not widely used by businesses and advanced technologies are not widespread.

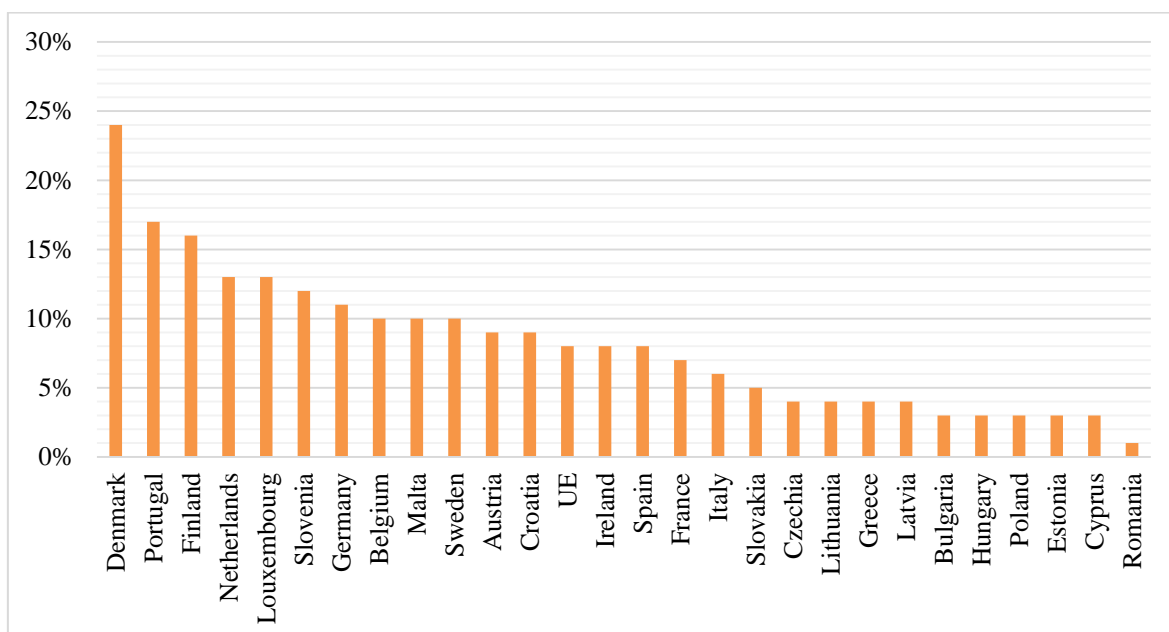


Figure 4. Enterprises using an AI technology (% of enterprises), 2022

Source: Eurostat, European Union survey on ICT usage and e-commerce in enterprises

A sectoral overview shows that in 2021 the ICT sector was ahead in the use of AI technologies with 25% of enterprises adopting AI, followed by publishing activities at 18%. Other sectors, adopt the AI in the following way: travel agencies - 8% of enterprises; electricity, gas, steam, air conditioning and water supply - 8%; real estate activities - 7%; manufacturing - 7%; accommodation - 7%; wholesale and retail trade; repair of motor vehicles and motorcycles - 6%. The use of AI technologies shows an uptake of about 5% in transportation and storage and the construction sectors.

Digital services in the EU are regulated by the Digital Services Act (DSA) and the Digital Markets Act (DMA). These rules contribute to creating a safer and more open digital space, where the rights of users of digital services are protected; they establish fair competition conditions to stimulate innovation and competitiveness. In 2021, 20% of small and medium-sized enterprises in the EU produced online sales amounting to 12% of the total turnover. In the period 2015-2021, the number of SMEs that sold online increased by 3%, and the turnover of these enterprises increased by 2%.

Businesses that sell online result in reduced costs, increased efficiency, and improved productivity. E-commerce has an important role for both large companies and SMEs, both on the domestic market and abroad. But in 2021, only 9% of SMEs produced online sales to customers from other EU countries.

The indicators regarding selling online and selling online cross-border are reflected in the European Union survey on ICT usage and e-commerce in enterprises. The analysis of the share SMEs selling online and selling online cross-border is presented in figure 5.

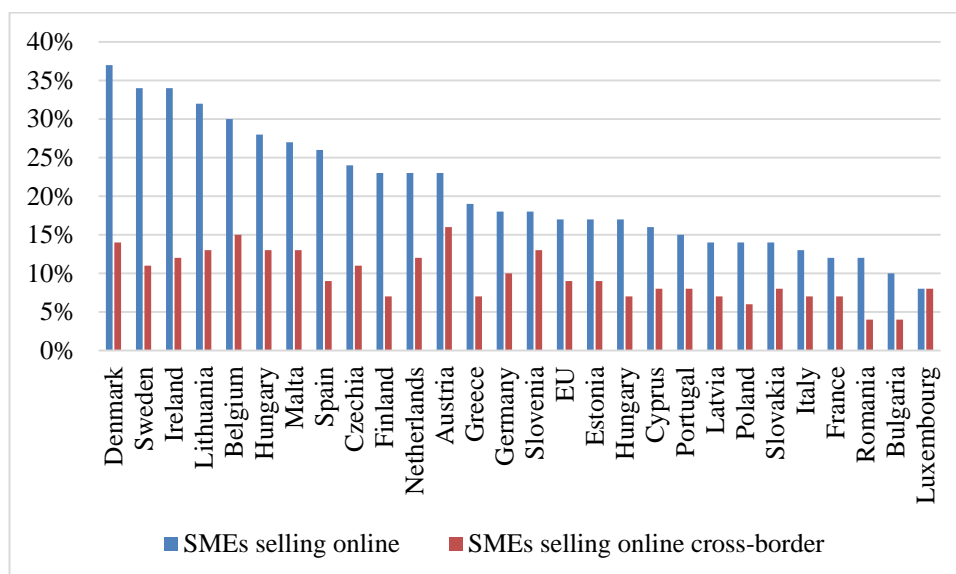


Figure 5. SMEs selling online and selling online cross-border (2021) (% of SMEs)

Source: Eurostat, European Union survey on ICT usage and e-commerce in enterprises

According to Eurostat data in 2021, SMEs from Denmark (37%), Sweden (34%), Ireland (34%), Lithuania (32%) and Belgium (30%) had the most online sales. In cross-border online sales Austria is the leader with sales of 16% out of all businesses, followed by Belgium (15%), Denmark (14%), Malta (13%) and Slovenia (13%)

The majority of SMEs (56%) with web sales in other EU countries have no difficulties in cross-border online trade. On the other hand, 43% of SMEs report at least one obstacle in online cross-border trade such as high costs of delivery or product returns, problems related to the resolution of complaints and disputes, and lack of knowledge of foreign languages.

E-commerce has certain advantages such as: faster buying process, cost reduction, available advertising and marketing, flexibility for customers, faster response to market demands, several payment modes, easier exports.

But there are also some disadvantages of e-commerce such as : potential security threats, competition, IT issues, shipping logistics, limited connection with customers.

E-commerce has helped businesses gain access and establish a wider market presence by providing cheaper and more efficient distribution channels for their products or services.

Conclusions

Thanks to the use of digital technologies, companies can gain competitive advantages, improve services and products, and have the opportunity to expand their markets.

The analysis of the use of cloud computing by businesses shows that 34% of EU businesses have purchased sophisticated or intermediate cloud computing services, such as finance/accounting applications, for managing customer relationship management

information and for planning their processes and resources. Significant differences can be observed between countries. In Sweden, Finland, Denmark and the Netherlands, at least 60% of businesses used cloud computing. On the other hand, in Greece, Romania and Bulgaria, less than 25% of businesses have done so.

Today, there is a massive amount of data used by businesses. With big data, it is possible to process large volumes of unstructured data. Big Data can help in various business activities such as product development, predictive maintenance, customer experience, fraud and compliance, machine learning, operational efficiency, driving innovation. The leader among European countries analyzing big data is Malta, with almost 33% of businesses followed by the Netherlands and Denmark with 27%. Only 5-6% of enterprises in Romania, Slovakia, Cyprus and Bulgaria analyze big data.

Applying artificial intelligence to save money, increase efficiency, generate insights and create new markets is changing the way businesses work. There are AI-based business applications to improve customer service, maximize sales, ensure cyber security, optimize supply chains, relieve workers of certain tasks, improve existing products, and develop new products. Adoption of AI technologies in European Union countries is quite low, of 8%. However, there are some differences between Member States. With regard to electronic commerce, we found that in 2022, 18,4% of small and medium-sized enterprises in the EU sold online. Online sales result in reduced costs, increased efficiency and improved productivity for businesses. E-commerce plays an important role for both large companies and SMEs, both domestically and abroad.

The analysis allowed to identify the level of digitalization of enterprises in different European countries. In European countries, business is increasingly digitized, but the use of advanced digital technologies remains low. Large companies in the EU are more digitized than SMEs, but they still have room for improvement. SMEs must be ready for implementing digital technology.

In these circumstances, the European Union must improve the legal framework in order to create favorable opportunities for the digitalization of enterprises in different countries.

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