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INTEGRATING TRANSPORT AND CUSTOMS FUNCTIONS FOR ENHANCED LOGISTICS RELIABILITY

International trade cannot exist without the efficient and reliable movement of goods across national borders. Recent global disruptions, including the COVID-19 pandemic and geopolitical instability, have highlighted the critical need to increase the resilience of logistics chains. A significant source of inefficiency and unreliability stems from the fragmentation between transport operations and customs procedures at international borders [4]. The profitable business of transport companies focuses primarily on moving goods, optimizing routes, scheduling, and minimizing the time required for transport from a producer to a consumer. Organizations using these digital technologies are more adept at managing complexity, improving decision-making, and providing value to stakeholders. The role of digital technologies in managing complexity should reassure the audience about the future of logistics. Although the advantages of digital transformation are considerable, its execution presents obstacles [6].

Delays and unpredictability in global trade logistics affect the system's efficiency and cost-effectiveness and directly impact customer satisfaction. Because Customs and shipping companies operate in isolation, often resulting in delays, increased operational costs, and significant unpredictability in supply chains, these border interaction issues impose substantial costs, severely affecting developing and landlocked countries. Despite the critical need for barrier-free global trade, there is often a fundamental fragmentation between managing international shipping and executing customs procedures. The supply chain paradigm implies a new way of viewing the organization, based on the integration of its activities into key processes rather than by departments [5]. For that purpose, public organizations have implemented electronic platforms, aiming to improve the coordination between PCS operators, thereby removing some inefficiency [8].

Historically and operationally, these functions have often been treated as distinct, sequential stages in the supply chain. Transport companies focus on logistics and asset management, while customs authorities focus on legal regulation, smuggling detection, and cross-border revenue collection. This separation creates critical interaction points, typically at ports, airports, and land borders, where cargo is received for entry into the country. These interfaces are often sources of significant bottlenecks characterized by delays, data inconsistencies, communication delays, and a general lack of coordination. For example, delays in filing necessary customs clearance documentation can hinder Customs' ability to conduct timely risk assessments, while slow communication of clearance decisions can hamper Customs organizations' operations. The transformative potential of intelligent logistics systems is evident in the seamless synergy between their components. For instance, an automated warehouse with IoT sensors and AI-driven

analytics can revolutionize inventory management by monitoring real-time stock levels, automatically reordering when necessary, and forecasting future demand based on historical data [2].

The benefits that arise from the integration process often manifest themselves in a manner that can be described as synergistic, whereby the combined effects produce results greater than the sum of the individual contributions. Minimizing delays can reduce direct costs, such as those associated with customs or detention fees, and improve the predictability of arrival times. The result of this process is the establishment of a self-reinforcing cycle in which accumulated time savings lead to gains in predictability, which then enable further efficiency improvements and cost reductions throughout the supply chain continuum.

Furthermore, it is essential to recognize that while the observed reductions in average clearance times and direct costs are indeed substantial, the benefits associated with increased predictability – in particular, the reduction in variability in clearance times – may arguably represent the most important economic advantage for modern supply chains, which are increasingly complex and interconnected.

Logistics costs depend primarily on transportation costs, warehousing costs, and administrative costs. Just-In-Time (JIT) inventory systems aim to optimize inventory levels. However, significant fluctuations in border crossing times force companies to maintain expensive inventories as insurance against potential delays, even when average transit times are relatively short. Various integration mechanisms are used to address this challenge, such as extended preferential treatment for Authorized Economic Operators (AEOs) or real-time status updates accessible through sophisticated software (SW) systems. These systems are specifically designed to increase the predictability of logistics operations. The potential for increased predictability in logistics operations should inspire optimism about the future of supply chain dynamics. The harmonized approach to data transmission promises to revolutionize the logistics system by eliminating inefficiencies and reducing the likelihood of errors in transmitted data. By defining a standardized data set based on internationally recognized rules and operations, mainly the OMV Data Model, we can expect a significant reduction in data errors and a substantial improvement in accuracy. This model provides a harmonized structure and standard definitions for data elements required across various border procedures, including those typically found in transport documents like the Bill of Lading (B/L data elements like a shipper, consignee, vessel, ports, cargo description, container numbers are mapped within the WCO DM structure) and customs declarations.

Instead of separate submissions for booking, shipping instructions, manifest, and customs declarations, the algorithm envisions an early submission of a core dataset encompassing essential information needed by all parties. This could be achieved through a single, comprehensive electronic message or a series of linked messages conforming to the WCO DM structure, transmitted via standardized APIs or potentially advanced EDI formats mapped to the WCO DM. This data would be captured once, ideally close to the source, and then reused and augmented throughout the journey via the integrated platform. The primary benefits are a significant reduction in redundant data entry, minimization of errors arising from inconsistencies between different documents, and, crucially, earlier availability of essential data for transport planning and preliminary customs risk assessment.

The Real-Time Event Trigger and Synchronization System is a paradigm shift from static, plan-based operations and dynamic workflows. The probability of errors is reduced by leveraging real-time data streams from various points in the supply chain, such as IoT sensors on containers or vehicles that track location and status, transportation systems that provide ship/flight updates, and Terminal Operating Systems (TOS). For example, a confirmed ship departure message from the transportation system could trigger the completion of the export customs process. For instance, Dutch Customs could obtain both the import declaration and ENS data directly from the ISCC, or indirectly from China Customs via their partnership with the ISCC [7].

A significant deviation from the planned ETA detected through vessel tracking could trigger a reassessment of the customs risk profile and alert downstream transport providers (e.g., drayage) to adjust their schedules. A container discharge message from the TOS could trigger the final stage of customs clearance processing for pre-cleared goods. A customs release notification transmitted instantly via the platform could trigger the authorization for the terminal to allow gate-out and signal the drayage provider to proceed with pickup. Smart contracts, potentially implemented on a blockchain layer for specific high-trust interactions, could automate the execution of certain actions based on verified event triggers (e.g., automatic release of payment upon verified proof of delivery). This real-time synchronization ensures that transport and customs processes remain aligned with the actual physical flow of goods, minimizing idle time caused by communication delays or reliance on outdated plans and enabling proactive adjustments [1].

Advanced analytical techniques, including Machine Learning and AI, would be employed to identify complex patterns, detect anomalies, and generate predictive risk scores. These techniques can significantly enhance the accuracy and efficiency of risk assessment in international trade. However, their implementation may also pose challenges, such as data privacy concerns and the need for specialized skills. Crucially, these scores would reflect the traditional compliance risks (likelihood of fraud, smuggling, security threat) and logistics reliability risks (probability of significant delay, likelihood of cargo damage or loss).

As a result, the decision-making framework improves as new real-time data becomes available. This allows for more detailed and effective decision-making. Shipments assessed as having low compliance and reliability risk could receive a faster approach, known as “green lane” release, an automated process starting from arrival at the customs point. The greatest strength of the Fast Corridor is its ability to digitalize the entire import process [3]. This procedure significantly reduces transit time and increases commercial efficiency. Shipments with a high compliance risk but low-reliability risk could be subject to documentation or cargo checks. Conversely, shipments with low compliance risk but high-reliability risk (e.g., a compliant trader using a consistently unreliable carrier on a disruption-prone route) could trigger proactive monitoring, contingency planning alerts for the consignee, or potentially adjusted resource allocation by customs to anticipate potential clearance issues upon late arrival. This approach optimizes the use of inspection resources while facilitating trade flows. That allows the shift from traditional customs operations aimed at post-declaration detection to proactive management of the entire supply chain, directly addressing the reliability objective. The reliability of global logistics has become increasingly vital to the competitiveness of

international trade. However, the continued fragmentation between transport management and Customs conduct often compromises it; such fragmentation results in bottlenecks, delays, data inconsistencies, and unpredictability in customs operations [9].

Conclusion

This article examines the standard functions, processes, and challenges in both areas and evaluates existing technological solutions, such as One-Stop Shop, Port Community Systems, APIs, and blokçeyn. Although these solutions offer new avenues for development, they often do not adequately address the imperative of fundamental process synchronization and complete data integration. The author proposes a conceptual algorithm to unify transport and customs functions to reduce disharmony between trading companies and the Customs Service. This algorithm is based on proactive data sharing, process synchronization, collaborative decision-making, and comprehensive risk management. Its main mechanisms include:

– harmonized data transmission following international standards, such as the OMV data model;

– real-time event triggers that synchronize workflows through APIs and real-time data feeds;

– an integrated risk assessment engine that combines maritime and customs information to forecast both compliance and reliability risks using advanced analytical techniques;

– digitally enabled collaborative protocols for exception management.

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References:

1. Ahsen, S. R. and Rundle, J. M. Customs and Humanitarian Logistics. Global Trade and Customs Journal. 2019, 4(14), pp. 154-168.

2. Bisogno, M., Nota, G., Saccomanno, A. and Tommasetti, A. Improving the efficiency of Port Community Systems through integrated information flows of logistic processes. The International Journal of Digital Accounting Research. 2015, 1(15), pp. 1-31.

3. Caballini, C. and Benzi, M. Fast Corridors: innovative customs processes and technology to increase supply chain competitiveness. The case of IKEA Italy. Transportation Research Interdisciplinary Perspectives. 2023, 21, 100909.

4. Gutium M. Development of the digitalization of the customs service in the Republic of Moldova. Information and Innovations. 2023, 18(2), pp. 48-55.

5. Hammadi, L., de Cursi, E. S., Barbu, V. S., Ait Ouahman, A. and Ibourk, A. A SCOR Model for Customs Supply Chain Process Design. World Customs Journal. 2018, 2(12), pp. 95-106.

6. Holloway, S. Digital Transformation in Supply Chain Management: A Systematic Literature Review of Trends and Applications. Preprint. 2024, doi: 10.20944/preprints202411.2423.v1

7. Hu, R., Tan, Y.-H. and Heijmann, F. A new approach to e-commerce customs

control in China: Integrated supply chain: A practical application towards large-scale data pipeline implementation. World Customs Journal. 2016, 2(10), pp. 65-82.

8. Tao, Y. The Application of Intelligent Logistics Systems in Supply Chain Management and Its Challenges: Case Studies of Automated Warehousing and Unmanned Delivery. Frontiers in Business, Economics and Management. 2024, 2(16), pp. 100.

9. Zhang, S. and Preece, R. Designing and implementing Customs-Business partnerships: a possible framework for collaborative governance. World Customs Journal. 2011, 1(5), pp. 43-62.