

LOGISTICS AND CUSTOMS HANDLING – NEW TECHNOLOGIES AND OPERATIONAL EFFICIENCY AND COMPLIANCE WITH INTERNATIONAL REGULATIONS

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Purpose: The aim of this article was to analyse the impact of modern technology on logistics and customs handling processes, with a particular focus on operational efficiency and compliance with international regulations.

Design/methodology/approach: Both theoretical and empirical research methods were used to develop the article. An analysis and search of the literature on the subject and legal acts in the field of logistics and customs services was carried out, with a particular focus on their use of new technologies in international goods traffic. In addition, empirical data from border and customs services were analysed. An added value was, the own observation allowing to complete the analysis in the field of logistics and customs handling.

Findings: One of the most significant challenges in managing logistics and customs operations is balancing the efficiency of processes with current regulations on security, transparency and compliance of international transactions. Process automation, information management systems, blockchain technologies and artificial intelligence (AI) are increasingly being introduced into the logistics sector to improve the fluidity of operations and minimise the risk of errors and discrepancies in customs documentation. However, the introduction of new technologies also poses challenges for companies in terms of their integration and adaptation to international regulatory standards.

Research limitations/implications: Limitations of the research primarily relate to the limited availability of operational data, the variety and variability of international regulations and the difficulty in measuring the impact of technology on operational efficiency and compliance. The pace of technological change and the need for organisational adaptation also limit the generalisability of results. Future research could focus on analysing the impact of specific technologies, such as IoT or blockchain, and comparisons between different countries in terms of regulation and implementation levels. It would also be worth investigating how regulatory regimes adapt to new technologies and how the development of employee competencies affects operational efficiency.

Practical implications: The article can provide companies with valuable insights into process optimisation and cost reduction. It can help companies understand which technologies, such as blockchain or artificial intelligence, best support security and speed in the supply chain, while minimising the risk of non-compliance.

Social implications: Lessons learned from this article can help improve the security and fluidity of the global flow of goods, which can translate into supply stability and product availability. More efficient customs processing, supported by technology, can reduce the costs associated with importing and exporting, which can ultimately lead to lower prices for consumers. Additionally, the use of innovations such as blockchain and artificial intelligence can improve supply chain transparency, which is particularly important in the fight against illegal trade and counterfeit products.

Originality/value: The novelty of the article lies in its analysis of the impact of the latest technologies - such as blockchain and artificial intelligence - on logistics and customs in the context of operational efficiency and compliance with international regulations. The article adds value by providing companies and institutions with concrete guidance on how they can use new technologies to increase efficiency, reduce costs and better comply with global regulations. It is primarily aimed at logistics managers, customs professionals and decision-makers and analysts responsible for strategy in companies operating in international markets. In addition, the article may be of interest to researchers and students in the fields of logistics, management and new technologies looking for modern solutions and inspiration for further research.

Keywords: logistics service, customs, new technologies, development, international trade in goods.

Category of the paper: Research paper, Literature review.

1. Introduction

Current globalisation processes, the dynamic growth of international trade and the increasing complexity of supply chains are making logistics and customs handling key elements in ensuring the smooth functioning of international transport operations. The requirements of today's economy, based on the rapid flow of goods and information, force companies to implement new technologies that not only increase operational efficiency, but also allow compliance with increasingly complex regulations at the international level.

One of the most significant challenges in managing logistics and customs operations is balancing the efficiency of processes with current regulations on security, transparency and compliance of international transactions. Process automation, information management systems, blockchain technologies and artificial intelligence (AI) are increasingly being introduced into the logistics sector to improve the fluidity of operations and minimise the risk of errors and discrepancies in customs documentation. However, the introduction of new technologies also poses challenges for companies in terms of their integration and adaptation to international regulatory standards.

The aim of this article was to analyse the impact of modern technologies on logistics and customs handling processes, with a particular focus on operational efficiency and compliance with international regulations. The article discusses technological innovations and their impact on optimising logistics processes, as well as the challenges of ensuring operations are compliant

with regulations in different jurisdictions. The article also attempts to assess the benefits of implementing new technologies, as well as the risks associated with their implementation in the logistics and customs sector.

2. Literature review

Logistics is nowadays becoming a key element of gaining advantage, and the proper alignment of strategies provides enterprises and supply chains with an appropriate level of customer service, timeliness or reliability of execution of individual processes. Consequently, these elements create not only a competitive advantage, but also the added value of the enterprise (Niedzielski, Tundys, Łozińska, 2021; Huk, Goń, Pękalska, 2019). One of the elements of creating this advantage is logistical customer service, associated and often equated with delivery. However, before delivery occurs, many activities are performed throughout the supply chain (Ying et al., 2016). The term 'logistics customer service' (LOC) itself consists of two terms: logistics and customer service. Logistics in its scope includes, but is not limited to: the planning, implementation, execution and control of accepted product flows. A logistical customer service strategy, on the other hand, aims to increase customer satisfaction, i.e. to maintain the level of customer service at the highest possible level (Gricer, 2021). Smyk, defined logistic customer service as the ability to act within the area of a company's logistics system, aiming to meet the needs of customers and provide them with optimal delivery times, high efficiency of operations and a high level of communication with the customer (2014). Logistical customer service, can be analysed from different perspectives (producers, suppliers, vendors and customers (Kadłubek, 2014; Wozniak 2017). In operational terms, it defines the need for standards and technologies through which flows of a physical and informational nature are possible (Sułkowski, Morawski, 2014). Nowadays, it is thanks to logistic customer service that it has become possible to form long-term and positive relationships with customers, which translate into satisfaction, the quality of services provided and company profit (Wojcik, 2022; Kolasińska-Morawska, Fernówka, 2018). Logistical customer service is divided into three types of elements: pre-transactional, transactional and post-transactional (Brząkała, 2023). Logistical customer service is supported by information systems that can contribute to competitive advantage in the market (Jedynak, 2017). Three categories of these systems are mainly used in the area of logistical customer service: ERP (from Enterprise Resource Planning), CRM (from Customer Relationship Management) and ECR (from Efficient Consumer Response). ERP systems are comprehensive IT tools that support the management of a company's resources in many business areas (finance, production, warehousing, sales, purchasing or logistics (Orłowska, 2023). In the context of customer logistics service, ERP systems integrate all processes related to supply chain management,

inventory planning, stock control, transport management and order processing (Galinska, Kopania, 2016). CRM systems, on the other hand, are focused on managing customer data and building customer relationships. In logistics, CRM is used to handle orders, personalise offers, manage customer contacts and analyse customer preferences (Tien, Diem, Van On, Anh, Van Dat, Hung, Tam, 2021). CRM systems can also support after-sales service and manage complaints, which the authors argue is crucial in B2C (Business-to-Consumer) and B2B (Business-to-Business) logistics (Chatterjee, Nguyen, Ghosh, Bhattacharjee, Chaudhuri, 2020). ECR is a system focused on collaboration between business partners (manufacturers, suppliers, retailers) to maximise supply chain efficiency and optimise customer service (Brząkała, 2023). ECR systems are designed to oversee the delivery of products to points of sale or directly to end customers in an efficient manner (in the minimum possible time and with reasonable transport and storage costs; (Wirtz, 2024). Extremely important for international business, especially in the context of logistics, is the process nature of the supply chain. The process approach is related to its construction within transnational corporations (Gołemska, 2022). The more important strategic objectives of companies, links in the supply chain, in the context of combining industrial and logistics policies, include: optimising the company's assets by reducing the level of inventories, transport costs and the costs of operating logistics centres; reducing transaction costs and undertaking value-creating activities for the customer; reducing the effects of market information asymmetry by rationalising logistics operations within the supply chain. Designing business models for future international supply chains is one of the most important tasks of logistics, although it is dependent on: the ability to converge logistics service levels at both the supplier and receiver of goods moving through the international supply chain; the magnitude of turbulence in global goods and services markets, with particular emphasis on exchange rate changes, price fluctuations, political and random factors; the level of diversification in the supply of natural raw materials, intermediate goods (Gołemska, 2021). Within the European Union, the implementation of policies to ensure the safety and security and legality of the import and export of goods is carried out, *inter alia*, by the customs authorities. Customs service plays a key role in international trade in goods, ensuring the smooth flow of goods across borders, the control and prevention of smuggling and illegal trade, the collection of customs and tax duties, the control of documents and the application of certain customs procedures (Chackiewicz, Orłowska, 2024). It is implemented multilaterally depending on the complexity of the customs clearance. In the case of standard clearances, which do not require the opinion of specialised bodies, the handling is carried out by the customs authority, the operator, the customs agency and the carrier. For more complex situations involving the movement of goods, freight forwarders, employees of free zones, warehouses, logistics centres, customs and tax warehouses are involved in the handling. In addition: sanitary, phytosanitary, veterinary and sanitary inspectorates depending on the type of goods being transported (e.g. plants, animals). In his reflections (Witkowski, 2018) on the importance of customs handling in the international supply chain, he assumed that it is a process constituting

a broad spectrum of specialised activities relating to the planning, organisation, execution and control of the flow of goods and services between its links located in different customs territories, from the producer through intermediate distribution stages in order to satisfy the needs of the final consumer. In terms of the activities carried out in this process, it is important to highlight the customs service's most often provided by a professional logistics company. Customs risk management (customs compliance) is obligatory in order to increase security in international trade in goods. This refers to activities involving, among other things, analysing, diagnosing, proposing appropriate solutions both organisational and procedural in the enterprise of international goods trade (Czyzhovich, Gafrikova, 2017). Activities carried out during customs handling include calculating the profitability of importing goods, selling or purchasing goods by an entrepreneur, authorising a customs agency to make a customs declaration, loading goods, transporting goods to the relevant customs office, ordering controls by other services or authorities (e.g. veterinary control, phytosanitary control, sanepid, environmental inspector), storage of the goods, completion of documents and preparation of the goods for customs and fiscal control, verification of documents by the customs authority, revision of the goods and means of transport (partial or 100%) in case of doubts as to the authenticity of the goods, taking and examining samples of the goods, presentation of the goods for customs control giving explanations, making the required documents available, loading of the goods, storage of documents for five years for the purposes of customs control (Chackiewicz, 2022). According to (Czyżowicz, Gwardzińska, 2011), customs services are part of the broadly defined logistics services. They constitute the object and effect of customs activities, which are directly related to the customs clearance of goods. They are also complementary to the processes of international trade in goods. IT systems in customs handling not only streamline customs processes, but also increase security and compliance with international regulations are used during certain customs procedures. These systems are compatible with those of the customs authorities, the Border Guard and other border services in EU countries. The following are selected systems: export, import, transit and a system for monitoring the transport of specific goods by road and rail. AIS (Automated Import System) is an IT system used for the handling of customs declarations, statistical declarations and other import documents. It checks the correctness of customs declarations, which speeds up clearance and minimises errors. It allows the status of customs declarations to be tracked, which consequently increases control over imports. AES - (Automated Export System) deals with the handling of customs export declarations and export summary declarations (WDS) and is uniform across EU countries. It ensures the electronic exchange of information between economic operators, customs authorities and guarantees efficient customs supervision. NCTS2 (New Computerised Transit System) - is used for lodging customs declarations for the transit procedure and monitoring transit operations. Thanks to the electronic form of communication, the system ensures the smooth completion of transit operations, the release of security, the reduction of costs, and the transparency of transit operations. SENT - System of Electronic Transport Supervision -

concerns the monitoring by the customs authorities in Poland of the transport of 'sensitive goods' and fuels by road and rail. Operators are obliged to declare transport in the SENT electronic register, to supplement and update it, and, in the case of a carrier, to equip the means of transport with a device transmitting geolocalisation data. The following goods, among others, are subject to control: alcohol, dried tobacco, oils, fuels, medicinal products, a complete list is included in (List of commodities under monitoring system). Access to the SENT System for entrepreneurs can be found on the Platform of Treasury and Customs Electronic Services (PUESC) in the e-Carriage tab. The system of control of carriage of commodities under monitoring, which is based on the provisions of the Act of 9 March 2017. Pursuant to Article 32 para. 2, the control is performed by the Customs and Fiscal Service, the Police, the Border Guard and the Road Transport Inspection. The following entities are responsible for sending, completing and updating notifications in SENT: shippers, carriers and consignees. Penalties of between PLN 2000 and 46% of the gross value of the goods transported, but not less than PLN 20,000, are applicable for non-compliance (Chackiewicz, 2021). From 1 November 2024, an obligation was introduced to report transport to the SENT register by foreign entities which are not based in a European Union Member State, the Swiss Confederation or a member state of the European Free Trade Association (EFTA) and perform transport on the territory of Poland for which a: a permit to carry out international road haulage on the territory of the Republic of Poland, an ECMT permit which entitles to carry out an unlimited number of transports between member states (Conférence européenne des ministres des Transports associating 43 countries from Europe), an exemption from the obligation to hold these permits, a permit for cabotage transport (<https://puesc.gov.pl/updates...>).

3. Research methodology

Both theoretical and empirical research methods were used to develop the article. An analysis and search of the literature on the subject and legal acts in the field of logistics and customs services was carried out, with a particular focus on their use of new technologies in international goods traffic. In addition, empirical data from border and customs services were analysed. An added value was the own observation allowing to complete the analysis in the field of logistics and customs handling.

4. Results

The analysis concluded that in international trade, new technologies play a key role in streamlining logistics processes, thereby increasing their efficiency and ensuring regulatory compliance. Blockchain technology is increasingly used in international trade, especially in the area of documentation and monitoring of supply chains. Blockchain enables the secure and immutable storage of data, which translates into better control over processes and also minimises the risk of fraud (Ar, IM, Erol, Peker, Ozdemir, A. IMedeni, Medeni, 2020). Blockchain-based commodity tracking is becoming increasingly common and allows for real-time monitoring of the origin of products, their transport and any activities in the supply chain. Which makes it possible to verify the authenticity of products and track every stage of their transport, which is particularly important in the pharmaceutical and food industries (Kucharczyk, Kucharczyk, Szpilko, 2021). This technology can also be used to store electronic versions of customs documents (invoices and certificates of compliance, which significantly speeds up control processes and reduces errors associated with manual data entry) (Brzezinski, 2020). AI and machine learning are used to automate processes and to predict future market trends based on data analysis. AI is also used to plan as well as optimise logistics operations (Kozłowska, 2024; AI analyses data on weather conditions, traffic volumes, market changes) to optimise routes, delays or reduce costs (Mroczko, 2023). Woschank, Rauch, and Zsifkovits (2020) describe the use of AI to forecast product demand based on available historical data and current trends which, in their view, translates into inventory management and the adjustment of production to market needs (Orłowski, 2022). The Internet of Things (IoT), on the other hand, allows goods, vehicles to be tracked and monitored in real time using a network of sensors and devices. The application of IoT in international trade, according to Guzowski, Aneszko, Giegiel and Szpilko (2022), has significantly improved supply chain control and security. In addition, IoT sensors in containers and vehicles enable the monitoring of transport conditions (e.g. temperature, humidity) and the location of goods, which is particularly important for sensitive products such as pharmaceuticals (Bielecki, 2022). In warehouses, IoT sensors are used to monitor inventory levels in real time and automatically generate replenishment orders and optimise warehouse layout (Drozd, 2022). New technologies also contribute to the automation of customs handling (EDI data exchange and digital platforms) making it possible to speed up border handling, reduce documentation errors and improve compliance with international regulations (Czaja, Boleska, 2024). Electronic customs clearance involves sending customs documents and invoices electronically, which speeds up border clearance processes, minimises the need for physical inspection of goods and reduces waiting times at the border (Zaborowski, Antonowicz, 2023). Another technology used in international trade in goods is single window systems. Platforms that allow companies to submit customs and transport documents through a single platform (the so-called 'single window' system) (Kim, Kim, 2020).

Another not to be missed technology that has been gaining popularity recently are drones and autonomous transport vehicles. Their use is expected to contribute to faster and more efficient delivery of goods, especially over short distances and to hard-to-reach regions. This is particularly true for delivery over the so-called ‘last mile’. Unmanned aerial systems are used to make deliveries over short distances, including in hard-to-reach areas (e.g. mountains, islands), reducing delivery times and operational costs (Orłowska, Orłowski, 2024). Autonomous vehicles, i.e. self-driving trucks and ships, can significantly reduce transport costs, and the risks associated with human error, while increasing safety and operational efficiency (Abosuliman, Almagrabi, 2021). E-commerce and marketplace platforms, are technologies associated with e-commerce platforms that enable multinational companies to sell products in global markets, integrating sales, customer service and logistics processes (Walczynski, 2023). Platforms such as Amazon, Alibaba or eBay enable companies to access global markets, providing them with logistics, payment and customs support (Reikowska, 2023).

5. Discussion

In the area of logistics and customs operations, there are many regulations in place at international, regional and national levels. These regulations aim to ensure that logistics and customs operations comply with international trade and security rules. International Convention on the Simplification and Harmonisation of Customs Procedures (Revised Kyoto Convention): This is one of the main documents governing customs procedures, developed by the World Customs Organisation (WCO). The Convention seeks to simplify and harmonise customs procedures, which is crucial for logistics operations at a global level. Harmonised System (HS): The Harmonised Commodity Description and Coding System developed by the World Customs Organisation is a global standard for classifying goods that facilitates international trade and ensures compliance with customs procedures. The system is regularly updated, which means that companies have to keep up with changes in order to comply. In addition, the European Union has a number of regulations for customs and logistics handling, such as the Union Customs Code (UCC). The UCC regulates many aspects of customs, including the movement of goods, classification rules and customs controls within the EU. The UCC also provides guidance on digitalisation and the implementation of technological solutions such as electronic declarations. The World Customs Organisation has created the AEO programme (<https://www.podatki.gov.pl/clo/informacje-dla-przedsiębiorcow/aeo-i-uproszczenia-celne/aeo/>), which allows logistics and customs companies to become Authorised Economic Operators. AEO promotes security and simplified procedures for companies that meet certain standards for security and compliance management. The introduction of modern technologies, such as blockchain, can support the fulfilment of the AEO criteria. When transporting goods

related to endangered species, logistics and customs handling must comply with CITES regulations. This convention regulates the trade in plant and animal species, introducing restrictions that require special permits and supervision. It is also important to remember that in logistics and customs handling, the processing of personal data, especially that of customers and business partners, must comply with RODO. This requires advanced technological safeguards, which is important when implementing new technologies. International Maritime Dangerous Goods Code (IMDG): Regulations for the transport of dangerous goods by sea require logistics and customs handling to comply with IMDG. This requires appropriate labelling, notification and compliance with international transport rules. ISO standards for logistics and supply chain risk management: ISO standards, such as ISO 28000 (specific to supply chain security management), are voluntary standards that support companies in meeting international security and compliance requirements. The type and importance of customs services is embodied in the regulations of the Union Customs Code (UKC). The tasks of the customs authorities include the supervision of the Union's international trade, the support of free trade, the implementation of aspects of the internal market, the common commercial policy on trade in goods and supply chain security (Chrzęszcz, Walczuk, 2017). Customs authorities perform control activities to ensure compliance with customs and other legislation that regulates the import, export, transit, movement, storage and end-use of goods moved between the customs territory of the Union and third countries and the presence and movement within the Union of non-Union goods and goods placed under the end-use procedure. Customs authorities shall cooperate with economic operators and other authorities involved in international trade in goods. Traders involved in international trade in goods exchange information with the customs authority other than that required by the customs legislation, inter alia, with regard to cooperation in the identification and prevention of risks (Laszuk, 2016; Grottel, 2014). It is important to point out the dynamics of the changes taking place in, inter alia, customs handling of international trade in goods, which consequently involves following the changes in customs regulations. An important tool for entities is the Treasury-Customs Electronic Services Platform (<https://www.gov.pl/web/kas/platforma-uslug-elektronicznych-skarbowo-celnych-puesc>), run by KAS and updated on an ongoing basis. The 1956 Convention on the Contract for the International Carriage of Goods by Road (CMR), which aims to unify the rules for the international carriage of goods by road and to introduce simplifications and improvements. The Customs Convention on the International Transport of Goods under Cover of TIR Carnets (TIR Convention), done at Geneva on 14 November 1975, which aims to simplify and unify customs procedures in the international transport of goods by road. The TIR Convention is based on an international guarantee chain which provides security for customs and tax duties. The Convention on a common transit procedure, drawn up in Interlaken on 20 May 1987, ensures that the contracting parties are obliged to assist each other in the recovery of claims and to cooperate in the simplification of customs formalities. Regulation (EU) No 952/2013 of the European Parliament and of the Council of 9 October 2013 laying down the Union Customs

Code, Commission Delegated Regulation (EU) 2015/2446 of 28 July 2015. Commission Implementing Regulation (EU) 2015/2447 of 24 November 2015. Law of 19 March 2004. Customs Law. Act of 16 November 2016 on the National Fiscal Administration. Several of these regulations and standards relate directly or indirectly to new technologies used in logistics and customs handling. The Union Customs Code (UCC), places a strong emphasis on the digitalisation of customs procedures, such as electronic declarations and entries. The Authorised Economic Operator (AEO) programme of the World Customs Organisation (WCO): promotes the use of digital technologies and security systems for companies seeking Authorised Economic Operator (AEO) status.

Kyoto Convention on the Simplification and Harmonisation of Customs Procedures (Revised Kyoto Convention): recommends that AI supports the automation of simplification processes and the standardisation of customs procedures. In addition, the World Customs Organisation, which manages HS, is working with member countries to digitise and automate the goods coding system. In the context of the processing of personal data in logistics and customs, RODO requires the implementation of appropriate technological safeguards, for which blockchain technology and advanced data management systems (data management systems) are being used.

6. Conclusions

Logistics and customs handling are key elements in ensuring the smooth functioning of international trade in goods. Logistics and customs operators are faced with the need to implement new technologies to increase operational efficiency in accordance with current EU and international legislation. Within the EU, policies to ensure the safety and security of the transport of goods in accordance with international law are implemented by, among others, customs authorities. Customs handling is carried out in two ways: on the one hand by customs authorities and on the other by traders, customs agents, freight forwarders, carriers. It should be emphasised that customs handling plays a significant role in international trade in goods by, inter alia, ensuring the smooth flow of goods across borders, controlling and preventing smuggling of goods, observing the import/export of goods in accordance with established restrictions and prohibitions, controlling documents, protecting the fiscal policy of the Union through the collection of customs duties and the application of certain customs procedures. The integrated IT systems used in customs handling significantly streamline customs processes, but also increase security and comply with legislation. New technologies used in logistics and customs handling are contributing to operational efficiency through the use of advanced technologies such as artificial intelligence, blockchain and the Internet of Things (IoT). Among other things, these technologies support process automation, improve the accuracy and speed

of data exchange and enable better supply chain management, which consequently minimises delays and reduces operational costs. In addition, they are used to support compliance with international regulations and standards for logistics and customs handling. Compliance management systems, based on machine learning, enable automatic verification of documentation, which speeds up the customs clearance process and minimises the risk of legal violations. Additionally, they improve transparency and enable tracking of shipments (blockchain) at every stage of the supply chain. This minimises the risks associated with document forgery and increases trust among trading partners. However, it should be borne in mind that, despite its many benefits, the implementation of new technologies brings with it various challenges, for example: the need to adapt infrastructure, investment in staff training and the need to harmonise technology with various national systems and regulations. Therefore, according to the authors, this also translates into employment and professional qualifications and, consequently, changes in the employment structure in logistics and customs. The growing need for IT and data analytics specialists suggests that technological developments require intensive training measures to improve the professional qualifications of employees. Given the dynamic development of technology, further research into its impact on logistics and customs handling is recommended. Changing international regulations should also be monitored in order to maximise the technological potential as well as to develop optimal operational practices.

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