

PORT INNOVATIONS AND CUSTOMS SAFETY

Liudmyla Valuieva

PhD, Associate Professor, Institute of Maritime Law and Management of National University
“Odesa Maritime Academy”, Ukraine

e-mail: liud.valuieva@gmail.com, orcid.org/0000-0002-0603-1399

Summary

The article describes the main technological innovations used in Ukrainian seaports to ensure customs safety. The relevance of this topic stems from the general processes of globalization and reform within customs safety, as well as the challenging operating conditions of Ukrainian seaports during the war.

The purpose of this article is to assess the current level of customs safety in seaports through the prism of the introduction of new technologies. The object of the study is to ensure customs security using innovative methods.

To disclose the purpose of the work, general scientific (analysis and synthesis, induction and deduction) methods of theoretical knowledge are used. Using special methods, the essence of technologies is described such as: the introduction of the electronic platform "Single Window", the introduction of electronic customs declarations, the use of GPS tracking and RFID tags of electronic sensors; the creation of guidance centers; the use of container scanners, specialized X-rays and blockchain technology to control supply chains; video surveillance systems with artificial intelligence that integrate with other security systems, such as GPS tracking, RFID tags.

Conclusions are formulated regarding the impact of technologies on the work of customs authorities in the seaports of Ukraine and ensuring safety standards, combating smuggling, and reducing the risks of corruption, and further research paths are outlined.

Key words: technological innovations, seaports, customs, prevention, security, safety, risks, corruption.

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1. Introduction

Ukraine actively cooperates with international organizations and neighboring countries to improve customs security and combat cross-border crime. The customs service plays a key role in ensuring two important functions of the state: tax revenue to the budget of Ukraine and preventing threats to national safety by stopping attempts to illegally move goods, weapons, and drugs across the border.

Customs control in seaports of Ukraine is one of the important ones, since the largest number of goods in peacetime is moved across the border by the cheapest sea transport (during military operations, the emphasis has shifted to land transport). However, even in wartime, the effective organization of customs control in seaports affects the economic safety of Ukraine, support for defense capabilities, and international trade following international standards.

To reveal the purpose of the work, general scientific methods of theoretical knowledge, analysis, and synthesis were used. For example, knowledge of customs clearance technology gives an idea of the specifics of the work of customs authorities: before the vessel arrives at the port, customs authorities receive preliminary information about the goods being transported.

This helps to prepare for the inspection and identify possible risks. Documents for goods must correspond to the declared data. Based on this data, customs authorities check which goods were declared and whether all necessary taxes and fees have been paid. After the vessel arrives, customs authorities inspect the vessel, containers, holds, and cargo compartments. And in case of suspicions or risks, special technical means, such as scanners, are used to check the contents inside the container.

Using the comparative method, connections were identified in the use of innovations and new technologies, for example, the implementation of the Single Window electronic platform, the introduction of electronic customs declarations, the use of GPS tracking, the creation of control centers, and blockchain technologies for controlling supply chains.

So, let's move on to the characteristics of the innovations that have been introduced in Ukrainian seaports over the past decades. All of them are aimed at increasing customs security, simplifying customs procedures, and ensuring transparency. These technologies help reduce the risks of smuggling, increase the efficiency of customs authorities, and reduce corruption risks.

Analysis of recent research and publications. The issue of ensuring customs safety using the latest technologies was studied in the works of domestic scientists Professors A.I. Krysovaty, P.V. Pashko, V.V. Ivanov, and others. Among the foreign scientists who wrote about port innovations in customs security are Dr. Rodney Wood and Dr. Ransford M. Acheampong. These researchers have made a significant contribution to the field of port security and customs security through their research and publications. But given that the situation in this area is constantly changing, since progress does not stand still, it is constantly being studied to regularly strengthen security measures in ports around the world.

The purpose of the study is to assess the current level of customs safety in seaports through the prism of the introduction of new technologies. The object of the study is to ensure customs security using innovative methods. For example, the use of a well-known risk management system allows customs officers to determine which cargo or vessels may be potentially dangerous. Therefore, depending on the level of risk identified, different types of checks can be applied: from standard documentary to full physical inspection. If all checks are passed successfully, the customs authorities clear the cargo. This includes the calculation and payment of customs duties, taxes, excise duties, and other payments.

In seaports of Ukraine, customs authorities usually cooperate with other supervisory authorities: sanitary service, veterinary, environmental, etc. These authorities check the compliance of cargo with safety standards, environmental requirements and other regulatory acts. But in wartime, cooperation with the border guard service, which must escort the ship to the port, came to the fore.

The main innovations that contribute to the customs security of Ukrainian ports:

2. Implementation of the Single Window electronic platform, which unites all customs and other regulatory authorities. It allows participants in foreign economic activity to submit the necessary documents for customs clearance in digital format through a single interface. This significantly speeds up the process of information exchange between different services, reduces bureaucracy, and also reduces the possibility of errors and abuses. In addition, the system allows you to track the progress of cargo clearance in real time. There are possible areas of co-operation between countries regarding the supply of advance (pre-departure and pre-arrival) information in respect of import and export cargo. Such information sharing is vital for securing national borders, as well as for speeding up the flow of freight. Such information sharing is vital for securing national borders, as well as for speeding up the flow of freight (*Understanding the Single Window Environment*, p. 12).

3. Introduction of electronic customs declarations, which are submitted through specialized online systems, such as the Single Window. This allows entrepreneurs to submit documents for the import or export of goods in electronic format. All documents required for declaring goods are submitted electronically, which reduces the need for paper documents and the physical presence of individuals at customs.

Electronic declarations are checked using automated risk management systems (ARMS), which analyze the data provided, identify risks and signal customs officers that additional checks are necessary. This allows customs services to focus their efforts on goods that potentially pose a higher risk; allows access to the history of cargo clearance at any time; reduces the possibility of corruption, as the human factor and contact between declarants and customs officers are minimized. Electronic declarations significantly speed up the customs clearance process, as there is no need to wait for the physical movement of documents between different departments and institutions. Data is transmitted instantly, which saves time and reduces delays in international trade, digital submission of declarations is possible 24/7, which provides greater flexibility for business. Data submitted electronically can be automatically compared with information from other sources, such as GPS tracking, RFID tags or risk databases.

Electronic declarations also allow for rapid verification of large volumes of goods and exchange of information with other countries, which helps to combat international criminal groups involved in smuggling or illegal trade.

Electronic declarations reduce the possibility of human error, as data is entered automatically, checked and recorded in a digital system. Solutions such as MIC's Customs Software (MIC-CUST®) offer easy answers to the sending and receiving of electronic data, both when filing with customs authorities and exchanging information with third parties like a customs broker or freight forwarder (*Understanding electronic customs filing*). This helps to avoid inaccuracies in documents, which also contributes to increased customs security. The use of electronic systems reduces the cost of paper documents, reduces the time spent on clearance, and makes the customs clearance process transparent. By automating checks and using risk management technologies, customs authorities can better control the movement of goods and minimize the possibility of violations and smuggling, thereby improving the conditions for legal business.

4. Use of GPS tracking, RFID tags, electronic sensors

GPS tracking is the installation of GPS devices on vehicles (trucks, ships, railway cars) or containers. These devices constantly transmit geographic location data to servers where they can be viewed by logistics companies, customs services or goods owners. GPS tracking allows customs authorities and companies to see exactly where the cargo is at any time and in the event of a change in route or suspicious activity, measures can be taken quickly to verify the situation; planning and adjusting routes to avoid delays and unnecessary costs.

RFID tags (Radio Frequency Identification) are a technology that uses radio waves to automatically identify and track objects. RFID tags can be attached to containers or cargo to identify them during transportation. The RFID tag contains a unique code that is read using a special reader and when the cargo passes through a checkpoint, the system automatically identifies it and records the data.

RFID tags allow for quick and accurate identification of cargo without the need for physical inspection or manual data entry. Such systems with RFID tags simplify the processes of tracking, security, reduce the risks of loss or theft of goods and contribute to a more rapid

response to emergencies. Since each cargo can be identified automatically, this reduces the likelihood of errors and fraud during the transportation and accounting of goods. Cargo data becomes available to all participants in the process – customs, logistics companies, customers, which increases the level of transparency and trust between the parties.

Customs authorities can track the movement of goods across the border in real time, which helps prevent violations or smuggling.

Sensors are devices that measure certain parameters (temperature, humidity, pressure, movement, container opening, etc.) and can be installed on containers or vehicles. Sensors constantly monitor the specified indicators and send signals in case of any changes or deviations from the norm. If the container is opened without authorization or another non-standard situation occurs (for example, an increase in temperature or damage to the cargo), customs and the owners of the goods receive an instant notification. The use of sensors in law enforcement activities helps to track the legality of actions with goods during their transportation (*RFID GPS Trackers: Two Technologies, One Solution*).

5. Creation of Targeting Centers – these are specialized analytics centers used in the customs control system to analyze, monitor and identify potential risks during the movement of goods across the border. They use aggregated data from various sources: electronic customs declarations, cargo databases, information from international customs services, as well as data from GPS tracking systems, RFID tags, video surveillance, and other sources. The goal is to collect information about goods, vehicles, routes, and participants in foreign economic activity to identify potential risks.

The basis of the work of targeting centers are risk management systems (automated risk management – SARM). SARM is software that analyzes a large amount of data about goods, routes, vessels, and other factors to identify possible risks. It analyzes data about goods moving through customs based on historical data, behavior patterns, and possible risks. After this analysis, the system automatically indicates those goods or vessels that require more thorough inspection. For example, the system may detect a suspicious increase in the volume of a certain product, which may indicate potential smuggling, or a suspicious cargo transportation route. Automatically identify goods, vehicles or companies that are suspicious due to any deviations from the norm or the presence of previous risks.

Targeting centers cooperate with international customs authorities, exchanging information about potentially dangerous goods or smugglers (if cargo from a certain country is often associated with smuggling, the system automatically marks such shipments for more thorough inspection). Targeting centers also closely cooperate with state structures, such as border guards, security agencies and international customs agencies. This ensures the prompt exchange of information about potential threats in real time and allows customs officers to respond promptly to potential threats in the behavior of transport or cargo. Thanks to automated data analysis, targeting centers quickly identify potentially dangerous cargo, which significantly increases the effectiveness of the fight against smuggling, illegal drug trafficking, weapons, and cross-border crime in general. In Ukraine, analytical risk centers operate on the basis of the State Customs Service. They significantly increase the efficiency of customs control by helping to identify risks and focus resources on potentially dangerous cargo. This increases the level of customs security and reduces opportunities for smuggling.

6. Use of container scanners – **specialized X-ray** or other types of scanning devices that allow customs authorities to inspect the contents of containers without physically opening them. Scanners allow customs authorities to quickly detect violations, minimize inspection time and ensure inspection accuracy without physical intervention. This reduces the likelihood

of damage to cargo during physical inspection. They are actively used to detect weapons, drugs, smuggled goods or other dangerous items.

Modern scanners for container inspection are installed in: Odessa Commercial Sea Port, Pivdennyi Commercial Sea Port, Chornomorsk Commercial Sea Port, Mykolaiv Commercial Sea Port, Berdyansk Commercial Sea Port, Izmail Commercial Sea Port.

7. Blockchain for supply chain control

Some ports are considering the possibility of using blockchain technologies to track cargo in the supply chain. This ensures transparency and immutability of information about goods, their origin, customs operations and transactions with them. Let's imagine that the goods arrived at a seaport in Ukraine. Information about its shipment, transportation, customs inspections and final delivery is stored in the blockchain. This means that customs authorities can at any time view the full history of the goods: who sent it and when, through which ports it went, who was the carrier and how it was checked at customs. If someone tries to change the information or enter it falsely, this will be visible to all participants, making fraud impossible (*Blockchain in Supply Chain Management*).

The blockchain works on the basis of a distributed network of computers (nodes) that verify and confirm each transaction. Since each block in the chain is encrypted, and the system works using complex cryptographic algorithms, the data in the blockchain is reliably protected from unauthorized access. No single participant controls the entire system, which reduces the risk of fraud or data forgery. Once information enters the blockchain, it cannot be changed or deleted without a trace, which ensures data integrity. Participants in the supply chain, including customs, shippers, carriers and buyers, can have access to the entire history of cargo movement. This allows all parties to see exactly where the cargo is and confirm the legality of each transaction.

Blockchain allows you to ensure that information about the cargo has not been changed or forged. This is important for preventing fraud and forged documents that can facilitate illegal trade. The implementation of blockchain in customs processes requires significant technical resources and skills, in particular for integration with existing international systems in the global supply chain.

At the moment, the blockchain system in the Odessa Sea Port is in the implementation stage. In the future, this will significantly increase the competitiveness of the port and improve cooperation with international partners, but requires additional investments and training of personnel.

8. Video surveillance systems with artificial intelligence (AI)

Modern video surveillance systems with artificial intelligence functions are able to automatically analyze the behavior of transport and people in ports. AI can detect suspicious activity and promptly warn customs authorities and security. For example, if transport moves outside the permitted area, lingers too long in a certain place or violates established routes, or unauthorized access to prohibited areas, excessive number of people in the area or unusual movement routes, attempted theft, acts of vandalism or penetration into a high-security area.

Cameras can also track the movement of containers and other cargo, checking whether they are transported according to plan and regulations or not. Many AI systems are integrated with facial recognition and license plate recognition. This allows people and vehicles entering

or leaving the port to be automatically identified and checked against databases. For example, if a wanted person or vehicle appears in the port, the system immediately alerts the relevant services. In addition, AI can detect potentially dangerous situations such as fires, accidents, collisions or suspicious objects left unattended. In such cases, the system automatically sends notifications to security services or customs for a prompt response. Video surveillance with AI is often integrated with other security systems such as **GPS tracking, RFID tags** and access systems, which allows you to create a single system of control over all processes in the port. For example, if a vehicle with a certain license plate is detected in a restricted area, the AI system can check whether there is a corresponding permit to enter this area and, if necessary, block access.

Thus, AI minimizes the impact of human error, allows for constant monitoring without loss of attention or bias and quickly responds to potential threats, effectively controls large areas and warns security services in real time.

Based on the analysis of previous data, AI systems can predict possible risks and take preventive measures to prevent incidents.

Therefore, the implementation of video surveillance with AI functions in Ukrainian seaports is an important element for improving security and control over cargo and people. This reduces the likelihood of illegal operations in ports and contributes to a quick response to possible threats.

9. Conclusions

Thus, over the past decades, several innovations have been introduced in Ukrainian seaports aimed at increasing customs safety, simplifying customs procedures. These technologies help increase the efficiency of customs authorities and reduce corruption risks and the risks of smuggling. The main innovations, which are partially used for customs safety in Ukrainian ports, are: implementation of the Single Window electronic platform, introduction of electronic customs declarations; use of GPS tracking, RFID tags, and electronic sensors; creation of targeting centers; use of container scanners, specialized X-ray, and blockchain technology for supply chain control; and a video surveillance system with artificial intelligence that is often integrated with other security systems, such as GPS tracking, RFID tags, and access systems, which allows for a unified control system over all processes in the port.

But the situation at customs in Ukrainian seaports remains complex. Today, in addition to the war, blockade of ports, and reduction of cargo transshipment by sea, there are other problems in ports related to corruption in this area, the level of which has not decreased despite the use of technology. We have a wait in line at the border, when law enforcements force customs not to carry out customs clearance. And this applies to both import and export. Until there is no bribe, there is no clearance. We have already seen pressure on business and corruption schemes in the past, when authoritative positions in the Ministry of Infrastructure were held by people from the security forces. This is what Shota Khajishvili, co-owner of Risoil, said in an interview with the Center for Transport Strategies (*Koordynatsiina rada z nevyznachenymy koordynatamy. Chomu portovyi biznes "ne nadykhnusia" novoiu derzhavnoiu strukturoiu. 4 kvitnia 2025*). Phenomena such as the illegal reduction of customs payments and bribes for expedited cargo clearance, the illegal export of undeclared agricultural goods, especially grain, the export and import of tobacco products, fuel, and the declaration of dual-use goods as civilian equipment, etc., have not decreased. All this results in insufficient funding for the state budget of Ukraine and also poses risks to the country's security during wartime

conditions. Limited state funding complicates the modernization of customs infrastructure and the introduction of new technologies to combat smuggling and corruption. Although modern container scanning systems and other technologies have been installed for customs officers in some ports of Ukraine, a significant part of the infrastructure remains outdated. Manual inspection procedures are still used in many ports, which significantly slows down the customs control process and leads to low efficiency in detecting smuggling. The lack of highly qualified human resources also complicates the customs clearance process. This increases the risks to national safety, especially in cases involving the movement of prohibited goods, weapons, dangerous goods, etc.

However, even in wartime conditions, the introduction of such technologies as electronic declarations and automated risk management systems (ARMS) everywhere at ports will greatly increase the efficiency of customs work and ensure the protection of economic and public security.

The problems of technical backwardness can be solved through reforms and technical modernization of the customs system.

These issues can be the subject of further scientific assessments and analysis to improve security legal relations in the customs sector.

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