

DIRECTIONS AND PROSPECTS OF THE APPLICATION OF ARTIFICIAL INTELLIGENCE IN CUSTOMS AFFAIRS IN THE CONTEXT OF INTERNATIONAL RELATIONS

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Abstract: The article is devoted to analysis of vectors and specific features of AI solutions development in the field of customs service. Based on tracing the evolution of digital transformation in custom, conceptual model of AI integration in custom IT system is considered. Practical implications of AI systems introduction in customs, in particular within the context of international relations, are outlined, together with the examples of advanced experience.

Keywords: customs; artificial intelligence; international relations; evolutionary model; digital customs.

1 Introduction

Foreign economic relations of states, primarily foreign trade, are directly related to customs activities. Under the influence of the processes of globalization of global and economic relations of states, the formation of a mechanism for implementing various forms of international relations, customs law becomes a regulator of international economic relations and forms of protecting the economic security of states. The development of international customs relations follows the general trend of countries' inclusion in the world trading system. Integration of customs relations is expressed in the emergence of the World Customs Organization, customs services within various regional unions, in the conclusion of international treaties and agreements on customs issues, in the development of uniform tariffs, agreed upon systems for describing and coding goods, in the creation of regional international organizations that establish rules, regulations, and procedures for regulating foreign economic activity.

As it is known, the main subjects of international customs law are states and international organizations, whose activities extend to the spheres of international trade and customs affairs. The movement of objects across the customs border is carried out on the basis of common principles, which should be understood as the accepted guidelines of international legal regulation of relations in the field of interstate customs cooperation, that were formed in the process of customs relations development.

International customs law contains unified institutions used in regulating international trade in goods, for example, classification of goods, customs value, origin. That is, these institutions themselves do not regulate the import or export of goods, but are used in the application of specific tariff and non-tariff measures. The classification name of a product only facilitates the application of specific trade measures, but does not itself suggest these measures [1]. The same applies to customs formalities. Thus, while international trade law provides for the application of customs duties, restrictions and prohibitions (licensing, quantitative restrictions, certification, and other measures), international customs law ensures compliance with the above trade measures through customs formalities.

International legal acts do not contain provisions on how the national customs service should be organized and what competencies it should have. Exceptions are those rights of customs authorities that represent an integral part of international legal customs institutions, for example, customs control, customs

clearance of goods. However, the specific forms of implementation of these powers are already at the national level of the internal customs affairs of a separate state. Thus, the effectiveness of providing customs services depends on the efforts of a particular state.

Typically, the process of customs clearance of goods involves filing a goods declaration, customs control, collection of taxes, duties and fees, then releasing the goods in accordance with the declared customs procedure. In the 21st century, the procedure for actions performed during customs clearance has undergone significant changes due to the massive spread of the scientific and technological revolution achievements. Today, participants in foreign trade activities can electronically inform customs authorities about the arrival of goods into the customs territory, pay due customs duties, taxes and fees, while customs authorities, in turn, conduct customs control and release goods before arrival. Consequently, the activities of customs authorities are aimed at creating favorable conditions for doing business based on improving the quality and effectiveness of customs administration while optimizing costs, i.e., the activities of customs authorities acquire a service-oriented character [15].

Matsudaira [35] introduces evolutionary model specifically designed for the customs area, the Digital Customs Maturity Model (DCMM), the concepts of which are summarized in Figure 1.

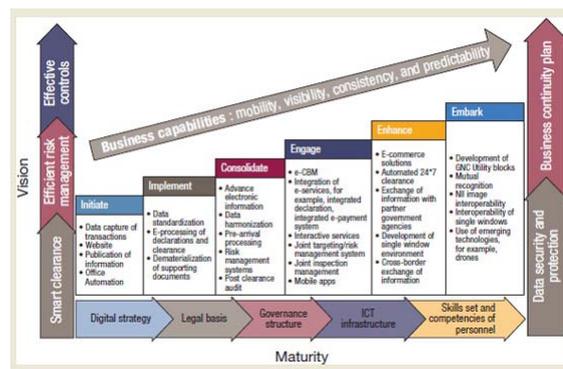


Figure 1. Digital Customs Maturity Model (DCMM) [35]

In turn, in order to ensure national economic progress and improve the quality of service to stakeholders, customs authorities are introducing digital technologies. In the customs control process, special attention is paid to the processing of declarations, namely, such components as risk management, data verification, and payment services [57]. With the help of information technologies, the quality of services provided not only to participants in foreign economic activity, but also to government authorities is significantly improved.

The priority vector of customs administration is to create a network of electronic customs offices, which are equipped with the most modern information technology and software tools, and have high-speed centers for operational monitoring and data analysis.

According to WCO Vision, "building blocks" of customs in the 21st century include the following [58]: "1) Globally networked customs; 2) Better coordinated border management; 3) Intelligence-driven risk management; 4) Customs-trade partnership; 5) Implementation of modern working methods, procedures, and techniques; 6) Enabling technology and tools; 7) Enabling powers; 8) A professional knowledge-based service culture; 9) Capacity building; 10) Integrity".

When carrying out customs control, authorities use data mining and carry out predictive analytics through the use of cognitive

technologies and advanced algorithms [2-4]. Because unstructured data is analyzed alongside predictive analytics, the best results can be to identify patterns and trends, track the history of compliance or non-compliance, and identify gaps and risks in the work performed. The essence of analytics is to extract valuable information from a huge array of sources. This is where artificial intelligence 'comes to the scene'. The main purpose of artificial intelligence technology in the implementation of customs control is the ability to structure the volume of data that customs services collect and goods, people, and vehicles generate.

The relevance of the use of AI in customs is due to the increased amount of information about goods and vehicles submitted for inspection, as well as the following number of factors [40]:

1. Limited time for making management decisions.
2. The difficulty of making the most correct (lawful) decision.
3. The need to accurately evaluate various alternatives.
4. Using the modeling method to predict the development of situations.
5. Making a decision based on a variety of initial data.
6. Using large amounts of data.
7. Integration and interaction with external data sources (including other executive authorities).

At the same time, the main advantages of AI application by customs authorities are:

1. A noticeable increase in the speed of task completion, through automation and increased productivity, without the involvement of additional labor resources.
2. Elimination of errors arising due to the "human factor".
3. Redirecting the activities of personnel (customs officials) to perform analytical work and solve problems that cannot be achieved using AI alone.
4. Multitasking and flexibility of automated processes.
5. Influx of new highly qualified personnel.

A person's physical capabilities do not allow him to operate with the amount of information necessary to control the correct classification of goods in accordance with the Commodity Nomenclature of Foreign Economic Activity. The lack of classification experience for the participant in foreign trade activities and the lack of time for the customs inspector during customs control before the release of goods is the reason for a large number of lawsuits and negative events after the release of goods for free circulation [13; 14]. It is obvious that the use of a cloud-based foreign economic activity aggregator based on AI, which involves solving one of the problematic and complex issues of foreign economic activity through an improved service for identifying and classifying goods in accordance with the Commodity Nomenclature of Foreign Economic Activity, will be equally in demand both by electronic declaration centers of customs authorities and by participants in foreign economic activity [20; 23]. The introduction of AI technologies into the activities of customs authorities during customs control and customs administration at the present stage of development should be aimed both at ensuring the national and economic security of the state and at creating a favorable environment for international business communities when carrying out foreign economic activity and international trade. The stage of creating artificial intelligence tools should be considered as a factor in the evolution of the system and a condition for the continuous development of customs activities.

2 Method

The theoretical and methodological basis of the study consisted of the works of scientists - specialists in the field of development of customs services, the procedure for performing customs operations and conducting customs control. The research used both general scientific methods (analysis, synthesis, measurement, logical modeling, induction and deduction) and special methods (method of expert assessments, customs statistics, etc).

3 Results and Discussion

Considering the model of the evolution of systemic intellectualization of customs activities, we note that different levels of intellectualization (intelligent, hybrid, and artificial) ensure the performance of certain functions. So, at the first level - the actual intellectual level - the competence potential of customs specialists is used to apply rational management methods and solve professional problems. The second level - hybrid intelligence - requires the use of competence and technological potential, an example is the performance of tasks by a specialist using information systems and technologies [5; 6]. At the third level - artificial intelligence - functions are selected taking into account the possibilities of automatically solving problems exclusively using technological potential. The fourth level of intellectualization is represented by the functions of systemic cooperation and social production, which should also be considered as an intellectual partnership, since the customs system is not only capable of solving problems independently based on information systems and technologies, but also ensures its continuous development in conditions of active interaction with external participants - business community.

Figure 2 shows the connection between functions, the possibility of their integration and transition between levels of intellectualization. In this case, the metasystem is the customs system, which is represented as a body of knowledge for solving professional problems [12; 17]. Ensuring the functioning of the system (s) begins with identifying information which enters the system and assessing the degree of its certainty (Y) for solving the task; then, alternately using intellectualization functions, the system develops in terms of competence potential (K) and technological potential (T) to the level of a hybrid intelligence, then the system is able to independently function and develop.

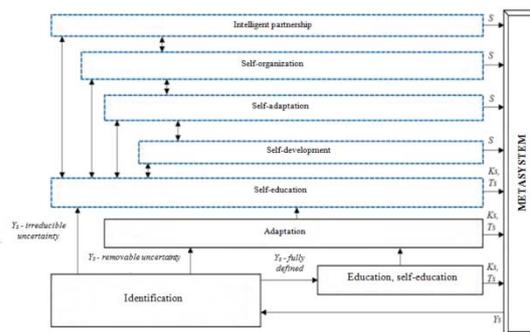


Figure 2. Intelligent Feature Integration Framework [18]

In modern management theory and practice, based on the ideas of AI, a new approach is being formed, which can be defined as multitasking or multimodal. 'Multitasking' means that solving problems or a set of management tasks is carried out on a single technological platform. A multimodal approach involves the systematic development of the intellectual capabilities of the functionality of machine (or platform) control intelligence. It is clear that in this case the platform and functionality are inseparable; developing intelligence is the coordinated development or self-development of the platform and management functionality [16].

Intelligent technologies and end-to-end processes actively fit into the activities of customs authorities, namely in the processes of analytical and monitoring activities, customs operations, including the use of inspection and screening complex [24-27]. The intellectualization of activities is accompanied by the acquisition of new properties by the customs system. At the stages of customs control, which are implemented without the involvement of an official, artificial intelligence technology is being developed in the perspective; at stages involving the cognitive competencies of officials, hybrid intelligence technology is being developed.

Table 1 presents a matrix of the main opportunities for introducing elements of artificial intelligence into the activities of customs authorities. Thus, the introduction of AI elements into the customs administration process will make it possible to both improve existing technologies (risk management system, data processing centers) and create new ones (digital diaries, smart checkpoint) [28-30]. The most promising direction today is the creation of smart checkpoints, which will make it possible to carry out customs control without the participation of customs officials, automate decision-making on the release of goods, and, as a result, would enable non-stop movement of risk-free supplies across the customs border.

Table 1: Matrix of possibilities for using artificial intelligence in solving problems assigned to customs authorities

Risk management system	Data processing center	Digital twins	Intelligent checkpoint
Automatic assessment of the risk level of consignments in real time	24/7 continuous operation of customs information systems	Analysis of the past, optimization of processes in the present, forecasting future results	Automatic weight and size, fluoroscopic, radiation control
Integration of risk management system segments at the supranational level	Processing large data sets	Automatic selection of customs control objects, including after the release of goods	Carrying out customs control without the participation of customs officials
Exchange of results of application of the risk management system between state regulatory authorities	Self-learning	Modeling the process of end-to-end customs control	Automatic decision making on product release
Data mining	Creation of a unified logistics process	Identification of the most significant deviations from the point of view of the likelihood of violation of the law	Non-stop movement of risk-free supplies across the customs border

It can be noted that the creation and further operation of an intelligent checkpoint will reduce the time costs associated with carrying out customs control at checkpoints while simultaneously increasing its effectiveness and efficiency [36-39]. Thus, further directions for the development of customs administration are determined by the transition to the creation of "intelligent" customs, characterized by a high degree of use of digital platforms and services, digitalization and automation of customs operations, and the rapid implementation of customs formalities, which together will lead to the effective implementation of the process of end-to-end customs control.

According to the authors studying the possibilities of using AI systems in customs, the mechanism for providing customs services by customs authorities within the framework of the end-to-end customs control process can be presented as follows [43]. The foreign trade participant, using the technology of the foreign trade participant's personal account, submits a declaration for the goods to the customs authorities, after which format and logical control is carried out in relation to it to the extent necessary to verify compliance with the conditions of automatic registration and automatic generation of the necessary package of documents for subsequent customs operations at a smart checkpoint. The intelligent module of the risk management system in the electronic declaration center allows assessing customs risks in real time, using methods of intelligent (semantic) analysis of information about the consignment declared in the declaration for the goods, as well as, in conjunction with the intelligent

module of the intelligent checkpoint, selecting further scenario of customs operations in relation to a consignment [43].

An intelligent checkpoint assumes the presence of three main corridors:

1. Green corridor. It assumes non-stop passage of risk-free consignments and applies in case of absence of detected violations (discrepancies) with the declared information upon arrival at the checkpoint and information reflected and submitted to the customs authorities earlier [32]. Namely in the green corridor, the customs clearance and customs control are most automated and have the lowest costs for foreign trade participants.
2. Yellow corridor. It is intended for consignments of the so-called medium risk level and is used if discrepancies are identified between the actual data upon arrival and those declared in the goods declaration (risks have been identified by country of origin, weight characteristics, product code, etc.). At this stage, the cargo must pass all stages of inspection by an intelligent system - automatic weight and size, X-ray, radiation control [33]. At each stage of verification, artificial intelligence analyzes the received data and makes an appropriate decision. If no violations were identified at any stage of the inspection, auto-release occurs and the vehicle departs from the smart checkpoint. If at some stage the risks are triggered, the system directs the vehicle through dispatch to the red corridor.
3. Red corridor. Vehicles for which risks have been triggered are sent to the red corridor. To minimize identified risks, customs officials carry out forms of customs control (for example, customs detailed inspection), including the use of technical means of customs control [34]. If, as part of the actual control, customs officials have identified facts of violation of customs legislation, the customs authorities take measures provided for by the legislation on administrative offenses and criminal offenses.

Thus, the customs administration system becomes more dependent on changes in external environmental conditions, as it becomes increasingly more focused on the development of foreign trade activities. A paradigm shift in the development of customs administration, due to a shift in emphasis from bureaucratic, control, and supervisory functions and a functional approach to a service-oriented and process approach to the regulation of foreign trade activities, is associated with the active introduction and implementation of digital technologies, platforms and services that allow assessing the results of the activities of customs authorities not only as the performance of functions and tasks, but also as customs services provided to participants in foreign trade activities [42].

From the moment container transportation began to be actively carried out (both within countries and cross-border), the need arose to use non-intrusive customs control tools, namely, X-ray scanning.

Typically, a cargo X-ray scanner scans 35 to 50 containers per hour. Those images that are uploaded to the scanner network are carefully analyzed by employees for anomalies. Such analysis seems to be a complex cognitive task and requires increased concentration, accurate determination of the location of the target along with available distracting factors. Errors often occur: for example, due to overexertion and fatigue, the human eye may not notice illegal cargo [22].

Currently, there are technologies for compressing images into a small format and cheaply storing information, which helps customs authorities collect, store, and archive X-ray images at a lower cost [41]. As a result, a large library of images is formed, which can be used both as a reference database for educational purposes and for developing automatic threat detection algorithms.

In China, since 2017, customs authorities have been exploring the possibility of using artificial intelligence along with

inspection equipment systems: due to testing, the machines were found to be quite effective in detecting restricted and prohibited items. Subsequently, automatic threat detection technology was introduced into China's customs inspection scanners and integrated into their customs information systems [8].

Dubai, one of the world's busiest trade hubs, is investing heavily in cutting-edge technology and harnessing the power of artificial intelligence (AI) to improve trade facilitation and border controls. These efforts are aimed not only at strengthening Dubai's position as an international trade and tourism hub, but also at setting new standards for customs operations and services worldwide, resulting in a positive impact on Dubai Customs' customer satisfaction index reaching 98% for smart and electronic services [11].

The "core" AI systems in use today correspond to reactive AI with limited memory. They can enable customs to make sense of the images and data generated by NII systems, cross-check data streams, analyze vast data sources to detect fraud, look for all types of risks and find anomalies.

Dubai Customs has harnessed the cutting-edge capabilities of blockchain technology to form strategic collaborations with leading free zones to create an innovative platform to facilitate cross-border e-commerce [44]. This platform easily integrates with the IT systems of various e-commerce companies. This collaborative network includes e-commerce businesses, courier companies, logistics service providers, cargo handling authorities and free zones. The platform contributes to building trust and transparency in the e-commerce ecosystem and also helps improve compliance levels.

When an e-commerce order is placed online by a company connected to the e-commerce platform, the order data is transmitted to the platform instantly. After receiving the invoice and shipment information, platform quickly creates a customs declaration by applying the policy benefits [45; 46]. The customs declaration clearance message is transmitted to the company and the free zones, allowing products to be quickly unloaded through the free zone gates. The platform allows identification of e-commerce companies which improves their servicing, automated preparation of declarations and their immediate execution, automated and instant refund of customs duties/deposits, providing duty exemptions and reductions in service fees, regulation of the return of goods by linking import and export declarations, ensuring 100% visibility and tracking of e-commerce transactions, enhanced flexibility for e-commerce companies 24/7, integrated pass for faster movement and delivery of goods [11].

As such, this innovative e-commerce ecosystem is not only shaping the future of the industry, but is also positioning Dubai as a global leader in facilitating e-commerce. From January to September 2023, AED 732 million worth e-commerce declarations (CIF value) were processed without any registration fees. More than 300 companies have registered with customs as commercial and/or logistics companies engaged in e-commerce operations [11].

In addition, the Remote Inspection initiative, developed in collaboration with strategic partner Dubai South, allows companies with AEO status in Dubai Logistics City to request customs to carry out inspections at specific locations within their territory using a robot equipped with thermal imaging and infrared video camera [48]. The camera is controlled remotely by customs officers, and the footage and related data are transmitted to the customs control room in real time. The remote inspector robot is powered by a long-lasting lithium-ion battery with fast charging capabilities.

Robotic Process Automation (RPA) uses intelligent automation technologies to perform repetitive office tasks such as retrieving data, filling out forms, or moving files. Dubai Customs uses RPA and IA to automate claims and refund processes [49]. Technical development teams have implemented an intelligent returns system that matches and verifies item details with

supporting electronic/scanned documents without any human intervention [50]. The implementation of the Smart Refund system provides key benefits to both businesses and governments in terms of promoting trade, reducing costs, and increasing the transparency of international trade transactions.

Robotic process automation and artificial intelligence have also been used to transform and improve another important aspect of customs operations - post-clearance audits. This step implies automation of some of the verification processes for import declarations of high-value goods [52; 53]. Five software applications, or "bots", need to be trained to automate repetitive processes such as data collation. AI has been integrated into their core functions, with bots using machine learning algorithms and natural language processing to interpret data and identify patterns. In addition to significant cost savings by eliminating the manual review process, audit automation is expected to impact revenue collection from audits. This will enable Dubai Customs to gradually increase its inspection coverage of high value import declarations from the current 19% per year (approximately 380,000 declarations) to 100% (2 million) over the next five years [11].

There are many more areas where customs can use AI to potentially transform trade processes and improve security [9; 10; 47; 59]:

- Automatic threat detection algorithms to search for specific patterns in X-ray images of all types.
- Predictive analytics (automatic analysis of historical trends to build predictive models).
- Automated document verification systems.
- Chatbots and Virtual Assistant.
- Records of transactions and cargo movements based on a distributed data registry (blockchain).
- Tools for anomaly detection.
- Drones with artificial intelligence support.
- Analytical platforms for collecting and analyzing customs data.
- Computer vision systems designed to use information obtained from digital images to automatically check containers for damage, tampering or hidden compartments.

The effectiveness of introduced intelligent AI system is evidently supported by statistics: the Jebel Ali and Tecom customs center at Sea Customs Centers Management, being one among Dubai Customs' departments, "remarkably crossed the two million bar by completing 2.189 million customs transactions in the first nine months of 2021 for goods with a combined value of AED 609.357 billion and volume of 79,369 tons" [31] (see Figure 3 below).



Figure 3. Jebel Ali and Tecom Center's performance in 1st nine months of 2021 [31]

Customs risk management systems using artificial technologies have now been implemented in a number of other countries. Thus, the international inspection company COTECNA, which assesses the quantity and quality characteristics of cargo, has been working closely with customs authorities of various countries for more than 20 years, improving its automated risk

A general methodological approach to determining the possibility of introducing artificial intelligence into customs technology can be implemented in the following steps:

- Customs technology that needs for or in which artificial intelligence can be applied and thereby increase its efficiency is selected;
- A verbal (descriptive) model of this technology is being developed with detail that allows identifying processes (operations) which can be replaced by artificial intelligence (according to regulatory documents and based on the practice of their implementation);
- Processes (operations) of the customs inspector are identified and examined for possible replacement with artificial intelligence;
- Artificial intelligence technologies are being developed that can replace the actions of a customs inspector;
- A new solution for the implementation of modernized customs technology as a whole is being developed;
- A preliminary assessment of the economic feasibility of replacing the current customs technology with a technology that performs the same functions using artificial intelligence is being carried out.

The solution generation module is the main one - it generates a solution similar to the solution that would be generated by a human operator. The module for generating initial data based on the analysis of input information, if necessary, optimizes incoming information, removing unnecessary information and adding missing one from external sources. The training module corrects decision-making algorithms based on error correction during selective control of the flow of decisions by a human operator and identification of violations detected in the external environment, and on the basis of a decision made by artificial intelligence. It is assumed that the level of training of artificial intelligence and filling the database of correct solutions provide the specified requirements for the system, for example, not exceeding the number of errors of the first and second types when performing customs control tasks [51].

One of the key challenges when implementing AI is ensuring the confidentiality of information and increasing the availability of databases. The process of maintaining internal privacy standards is paramount to reducing cross-border transfers of personal data, which could negatively impact the development of AI algorithms. However, personal data may be used in an area for which the data has already been collected, and cannot be used as part of a deep learning process for AI neural networks to improve the efficiency of service delivery methods. Creating strong privacy protections requires providing large amounts of personal data to study and improve AI programs. Based on this reasoning, the key challenge is to design privacy rules that do not place undue restrictions on AI access to big data [54].

The next problem is the development of uniform international standards in the areas of application of AI services. For example, the use of self-driving cars requires the development and unification of new standards for vehicle production and safety. On the one hand, this could lead to an increase in the cost of technological production, and on the other hand, it will create an international discussion about the compatibility of domestic standards of different manufacturing countries with the aim of eliminating trade barriers to trade in goods using AI algorithms. Another problem that can be highlighted is the protection of intellectual property rights for software products and provision of AI systems. This problem requires the development and implementation of methods to protect data from unauthorized copying and misuse of protected data.

In general, the use of AI systems in customs requires an integrated approach. An example of this approach is the interaction of Dubai Customs with stakeholders. As part of Dubai Customs' "AI Furdah Innovates 2022" activities during the UAE Innovation Month 2022, the Service Innovation Department organized three sessions on the future of innovation, supply chains and digital transformation in customs sector in cooperation with the Rochester Institute of Technology

University- Dubai and the Global Innovation Institute (GINI). The sessions, which saw the participation of more than 300 employees, clients, researchers and partners, aimed at sharing scientific scenarios and spreading academic knowledge to enhance and further develop services and practices in digital transformation. "Innovations and advancements have helped us top the GINI list, which puts Dubai Customs as the most distinguished organization in the Middle East list and the first government department worldwide to achieve this unprecedented feat. GINI report on the Middle East 2021 stated that the UAE is among the most active in innovation, and Dubai Customs is the most innovative organization in the Middle East" [11].

Thus, increasing the efficiency of the customs service with the help of AI tools can not only strengthen the positive vector in the development of international relations, but also become a driver for the development of Industry 4.0 in a particular country and increase the country's ratings in the global economic space.

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