ICCPT 2019
May, 28-29, 2019, Ternopil, Ukraine

ICCPT 2019: Current Problems of Transport: Proceedings of the 1st International Scientific Conference, May 28-29, 2019, Ternopil, Ukraine

Ensuring effectiveness in handling the movement of goods and passengers by enhancing information and communication technologies

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Abstract: The purpose of this paper is to propose measures for maximum practicable use of information and communication technologies in Ukraine while on cross-border movement of goods and means of transport. For today Ukraine has been intensively implementing the Single Window system, almost completely switched to electronic declaration as well as electronic submission of the documents and information required for official controls of goods belonging to entities or self-employed persons. A passenger declaration, filled out in advance and sent to customs authorities, for goods in accompanied/unaccompanied baggage or freight shipment can also significantly simplify procedures at a border crossing. The effectiveness of the measures proposed is proved using system analysis of well-structured problem by applying critical path method in a PERT diagram and Monte Carlo method for determining optimal time characteristics of handlings. Modeling alternative sequence scenarios of the process of customs clearance at the customs offices of departure and destination allows determining additive components of the total delivery time within customs territory of Ukraine. The scenarios include improvements in Single Window system, establishment of information and communication system for e-declaration of natural persons' goods and currency valuables. In this regard, first and foremost, experience of different countries on these issues as well as organisational, legal and technical difficulties are analyzed, and then directions for the development are outlined using mini-Delphi approach. In summary, the theoretical relevance of the research lies in the development of the mathematical model for the processes described, practical application of the improvements will reduce delays and additional delivery costs.

Keywords: passenger transportation, delivery of goods, border crossing, single window, e-declaration.

1. Introduction

According to the provisions of the Kyoto Convention «simplification and harmonization can be accomplished by applying maximum use of information technology» [1]. In Ukraine electronic declaring for goods is carried out using electronic customs declaration, certified by electronic digital signature, and other electronic documents or their details to the extent permitted by applicable law (paragraph 2, Article 257 of the Customs Code of Ukraine (CCU), 2012). By paragraph 4, Article 257 of the Code an accredited key certification centre has been set up in the system of the central executive body that ensures the formation and implementation of the state tax & customs policy. The centre provides all the necessary services, concerning electronic digital signature, free of charge to the territorial bodies at the regional and local levels and enterprises. The format of customs declarations submitted as electronic

https://doi.org/10.5281/zenodo.3387287

Peer-review under responsibility of the Scientific Committee of the 1st International Scientific Conference ICCPT 2019: Current Problems of Transport

documents is based on international electronic data interchange standards (paragraph 5, Article 257 of the CCU). The additional information required for the identification of goods is filed into the electronic invoice, which is added to the customs declaration [2, 3].

Customs clearance begins at the moment a customs declaration is filed by a declarant, as well as documents for processing and the goods selves. In other words a local contract holder or his authorized representative makes a statement of accurate and reliable information about the goods, the purpose of crossing the customs border of Ukraine and other information necessary for customs supervision. The goods must be declared no later than within 10 days from the moment of their delivery to the customs office of destination or placed in a temporary storage warehouse (or customs warehouse) [2]. However, in practice, it is not all that simple. The customs clearance of each item of goods requires an individual approach, perfect knowledge of the customs, tax and currency legislation of Ukraine, the nuances of processing a range of documents, the ability to interact with customs and other regulatory bodies. Depending on the customs procedure, under which this or that product is placed, and special aspects of crossing the customs border of Ukraine the optimal pattern of its customs clearance, the procedures for filing and filling in documents, calculating customs payments, determining non-tariff regulation measures and the country of origin are defined. All the details of sales agreement are scrutinized. The customs authorities have to verify the accuracy of the customs declaration and preferential documents. For that purpose they may initiate a goods examination. One of the key tools for simplifying their task and facilitating cross-border trade is to harmonize the work of all government agencies that provide permits for the import and export operations. They are veterinary and sanitary agencies, phytosanitary agencies, state agencies monitoring compliance with food laws, certification authorities and so on [4, 5]. Moreover some products are subject to export or import licensing [6]. Licenses or approvals are issued by state bodies such as Ministry of Economic Development and Trade, Regional Administrations, State Service of Ukraine on Medicines and Drugs Control, Ministry of Agriculture and Food Industry, Ministry of Health and others [7]. A listing of documents required for customs clearance depending on transport mode is defined by Article 335 of the CCU. Also documents to determine the custom value of goods and additional documents specified by the applicable legislation of Ukraine have to be submitted. Because of the constant and swift changes of required documents, competent authorities, customs procedural formalities in Ukraine foreign exporters are advised to vest customs clearance as contract liabilities of the Ukrainian trading partner [8]. Obviously, the availability of exhaustive information on arrangements for a product import/export and the simplicity in submitting accompanying documents can significantly shorten transaction time. The research dwells upon the results of relevant initiatives in Ukraine and development of a model that allows estimating efficiency for improvements proposed by experts.

2. Materials and Methods

Analysing arrangements for the Single Window system in different countries. The World Trade Organization and the World Customs Organization comprehensively encourage the introduction of state control of goods on the basis of the Single Window principle, through which the trade operator can quickly obtain all the permits necessary for the movement of goods. Positive experience of implementing the Single Window system already exists in many countries [9-13]. A striking example of the early introduction of the Single Window is *Singapore*. Launched on Jan. 1, 1989 Singapore TradeNet System became the first national electronic trading document system in the world and linked several government agencies. In 2007 a new TradeXchange platform was introduced that facilitated the exchange of logistic and commercial information for parties from the public and private sectors and offered additional services for managing supply chains, filling out documentation, trade financing and insuring. For now all TradeXchange e-services have been migrated to the Networked Trade Platform [9]. The system is paid and based on monthly fees and transaction fees. Presently, 10 minutes after submission of documents, traders receive an electronic response describing the terms of obtaining the permit or the detailed reason for the refusal. About 9 million submissions for trade permits are processed per year (30 thousand per day).

The desire to make the port work in Hamburg more efficient launched the National Single Window system in *Germany*. It is currently managed and owned by a private company, which is divided into three parts by shareholders: one-third belongs to berth operators, one third to ship agents and owners,

and the last one to freight forwarders. The system is mandatory only for dangerous goods and export goods subject to customs supervision. The main users of the system are freight forwarders, warehouses, logistics companies and departments of industrial and manufacturing businesses. System clients pay money for using it. They are provided with an individual code and password, and the data comes only to the specified addressee, registered in the system. One of the greatest achievements is the dramatic reduction in docflow and re-entering data due to the standardization [10].

Executive Order No13659 signed February 19, 2014 – Streamlining the Export/Import Process for America's Businesses – directs 47 *United States* Federal agencies with a role in trade to be ready to participate in electronic "Single Window" by December 2016. Now International Trade Data System is a part of U.S. Customs and Border Protection (CBP)'s Automated Commercial Environment. It connects the trade community to CBP and the other federal government agencies that regulate imported and exported goods [11].

The *Finnish* authorities have begun implementing the PortNet National Single Window system in the nineties. PortNet is a multifunctional single system for participants that deliver goods by sea. Since launch, PortNet has drastically reduced the need for filling and processing paper forms. The main lesson of Finnish success is that an effective system can be created with relatively little efforts and in a modern form, provided the state supports and the political will.

Korea's Single Window system uTradeHub was launched online in 2008 interconnecting the customs administration system and the systems of 56 public agencies. A lesson from Korea: it is necessary for countries that have established single windows to make full use of the procedural arrangements and technical instruments available to facilitate interagency coordination and participation of all stakeholders, including private sector representatives [12, 13, 14]. In 2018 the Korea Customs Service (KCS) launched the "Fourth Industrial Revolution and Smart Customs" programme. New platform, based on blockchain technology, will be established enabling all actors in the logistics chain (including manufacturers, exporters, transporters, government agencies, importers and consumers) to share reliable real-time information [15].

Analysis of some indicators that determine the effectiveness and level of comfort in doing business in the countries mentioned as examples of the good practice for trade facilitating is conducted on the basis of the data from the Logistics Performance Index (Figure 1-4). The World Bank Database gives an opportunity to measure the total burden of preparing the bundle of documents as well as to estimate time and cost for customs clearance and inspection procedures, conducted by other government agencies, and for handling that takes place at a port or a border crossing (Figure 5-6) [16,18].

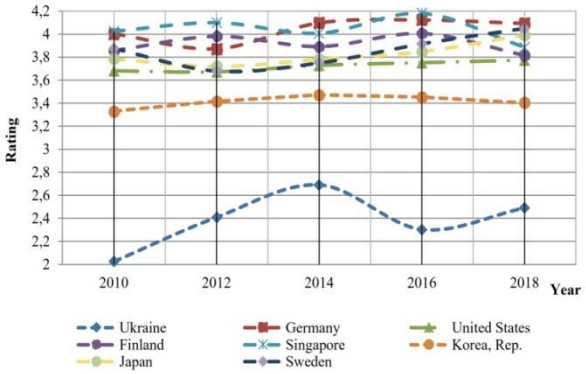

Figure 1. Efficiency of customs clearance process (1=low to 5=high)

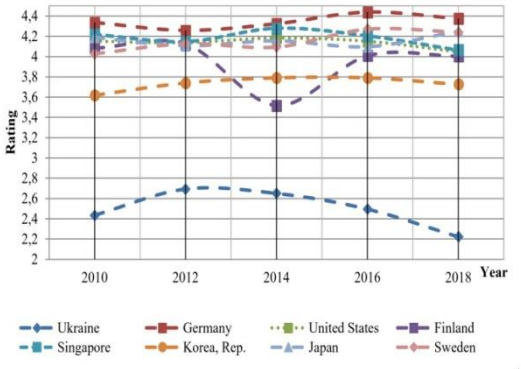

Figure 2. Quality of trade and transport-related infrastructure (1=low to 5=high)

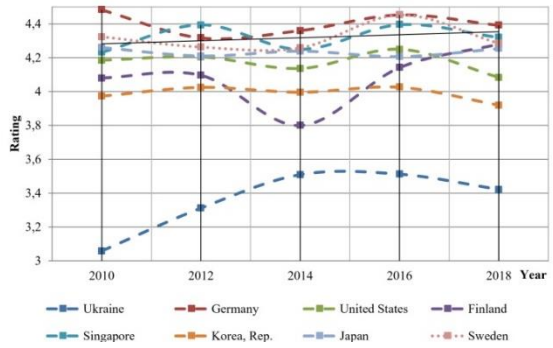

Figure 3. Frequency with which shipments reach consignee within scheduled or expected time (1=low to 5=high)

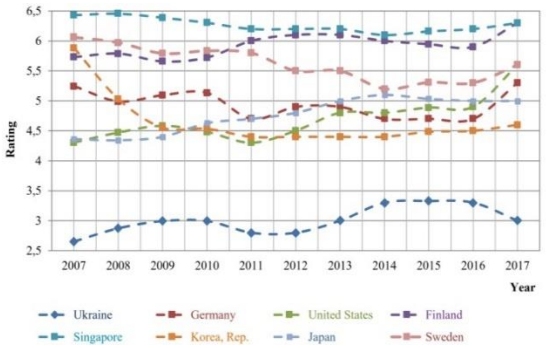

Figure 4. Burden of customs procedure (1=extremely inefficient to 7=extremely efficient)

Burden of customs procedure measures business executives' perceptions of their country's efficiency of customs procedures. The rating ranges from 1 to 7, with a higher score indicating greater efficiency. They are from the World Economic Forum's Executive Opinion Survey, conducted for 30 years in collaboration with 150 partner institutes [16].

Logistics professionals rate the level of satisfaction with customs higher than with other state bodies. In Ukraine customs authorities employ IT systems to process declarations and use risk management, consider international standards developed by the World Trade Organization and the World Customs Organization. But other agencies have not been modernized to the same extent, therefore interaction is not as fruitful as businesses would like. It is obvious that the level of comfort depends mainly on the economic and social development of the country.

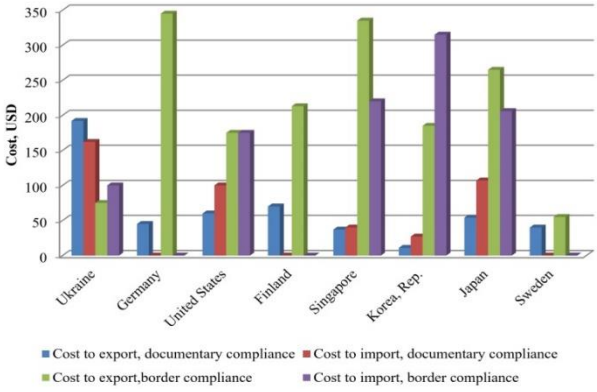

Figure 5. Cost to export/import, 2018

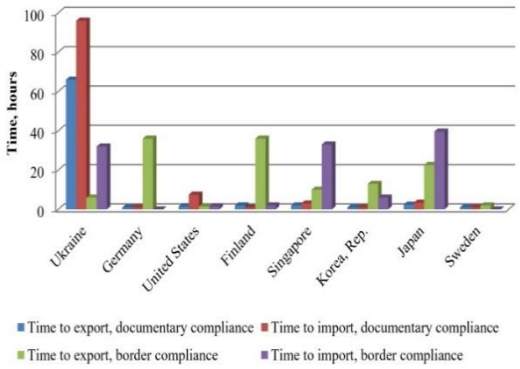

Figure 6. Time to export/import, 2018

The time and cost for documentary compliance include the time and cost for obtaining, preparing, processing, presenting (for example showing a port terminal receipt to port authorities) and submitting documents. The computation of border compliance time and cost depends on where the border compliance procedures take place, who requires and conducts the procedures and what is the probability that inspections will be conducted. If all customs clearance and other inspections take place at the port or border, the time estimate for border compliance will take this simultaneity into account. The border compliance time and cost could be negligible or zero in the cases of trade between members of the European Union or other customs unions. If some or all customs or other inspections take place at other locations, the time and cost for these procedures are added to the time and cost for those that take place at the port or border.

Currently Ukraine is also actively implementing the Single Window mechanism. In accordance with the Customs Code of Ukraine, this is a mechanism for interacting declarants, their representatives

and other concerned parties with the customs agencies, other state bodies, institutions and organizations authorized to exercise licensing or control functions concerning the goods and vehicles for commercial use crossing the customs border of Ukraine. It provides for nonrecurring filing electronic documents and information with the state information web-portal "Single Window for International Trade" in order to meet the requirements of the laws and international treaties of Ukraine. This interaction is carried out with the use of the information and telecommunication system of customs authorities. In practice the main result of the Single Window implementation in Ukraine is the receipt of an electronic notification about the decision on the verification of goods crossing the customs border. It is assumed that the use of this mechanism will significantly reduce the time of customs control procedures, as well as financial costs and corruption by simplifying the documents flow and refusing paperwork. However, after the introduction of the Single Window in Ukraine, the declarants named a number of sticking points: the lack of clear rules for communication between customs, official control services and businesses; lack of awareness and limited experience of public officers in the use of the Single Window; inconsistency of work schedules of control agencies and customs offices, the requirements for submission of documents in paper form (in certain cases). Entities engaged in foreign economic activities also create difficulties because of outdated ways of filing documents or maintaining accounting records. In this case, an application is submitted to the customs authority with a request for the permanent execution of documents in paper form. Another drawback is considered to be difficulties that arise when it is necessary to make changes to the already issued additional or preliminary customs declarations or to cancel them, to withdraw funds reserve and so on.

Summarizing all above-mentioned problems and perspectives of the Single Window, enhancing information and communication technologies for customs supervision of legal entities and natural persons' goods received priority in Ukraine for now.

Table 1. Advantages and disadvantages of the electronic data exchange system in Ukraine (named by declarants).

Benefits of the Single Window	Limitations of the Single Window
It simplifies and reduces the number of customs formalities.	The need for additional amendments to the regulatory framework for electronic declaration of goods and other documents related to different types of inspection.
It reduces the time for certain customs formalities.	It does not guarantee shorter deadlines for obtaining permits than with a paper submission of documents directly to the inspector of the State Committee for Consumer Goods and Consumer Protection.
It minimizes the human factor in making decisions by customs officers and supervisory authorities.	There is still the subjectivity of some inspections regarding the targeted application for passing certain types of inspection.
It eliminates the corruption.	Despite the available supporting documents there is the need for inspection of wood packaging materials and proof of payment for this procedure.
It allows "covering a larger territory" for one customs office.	There is a lack of inspection officers for passing all necessary types of inspection at one customs office (for example, at a border crossing).
It promotes the development of international trade.	There is a lack of software and hardware tools.

Modeling alternative sequence scenarios for customs clearance procedure using project network. For the initial stage of the research organisational, legal and technical difficulties have to be analyzed, and then directions for the development are to be outlined using structured forecasting approach. Structured groups of exporters/importers or their authorized representatives and customs officers answer questionnaires in two rounds for revising their earlier replies in the light of common opinion of these two groups and for proposing new directions of the system development. As the result of

face-to-face meetings, mini-Delphi technique is applied. Reduced scale Delphi studies provide more carefully considered viewpoints than the use of single round surveys [17]. The first round gives the following summarising problems prescribed by the group of declarants (Table 1).

According to the experts, the Single Window system has improved electronic declaring. The new regulations [5, 17] eliminate most of the gaps. However, declarants revealed the aspects that still delay passing different types of inspection and customs clearance. The results of the second round are to be summarized in a following article.

On the basis of regulatory provisions and experts description a customs clearance procedures sequence is depicted using network planning method. Network planning as a method of graphic modeling of operations has several advantages: it illustrates the sequence of the elements to be completed; it allows making up a business plan, computing float values and revealing hidden material resources. The program evaluation and review technique (PERT) are applied to optimize the network. To determine a critical path the longest sequence of dependent activities is to be identified and their completing time is to be estimated. It allows prioritizing activities for effective project management: to shorten the critical path of the project by pruning critical path activities; to perform more activities in parallel; to shorten the durations of critical path activities by adding material resources. The case studied in the course of supply chain for fabric rolls on wood pallets from Turkey (Figure 7). The network graph should be constructed so that there is no cycling of the process and the arrows (activities) do not overlap. However, for the process presentation in the article non-core canons are put aside.

Experts estimated time parameters of each milestone, therefore, this network shows not the early (late) start (finish) time of the events, but the minimum (t_{min}, optimistic), average (t_{av}, most likely) and maximum (t_{max}, pessimistic) time duration. According to this method the expected time for certain work is defined as $(t_{min}+4\ t_{av}+\ t_{max})/6$. For simulating model the Petri Net as programming tool is used (Figure 8, 9). However, to determine the durations of all the activities it is used not the estimated time, the calculation algorithm of which is shown above, but the Monte Carlo method. The principle of the method is to simulate a system operation as stochastic process. The simulation is carried out in the following steps: developing the chart flow for the process; programming the algorithm in VBA; generating input stochastic variables from specific distributions (Table 2) and repeating the experiment; statistical processing of simulation results.

3. Results

Hence overall time duration of critical path 1-2-4-5-7-10-11-12-13-14-15-16-17-18-19-20-21-22 is 132 hours.

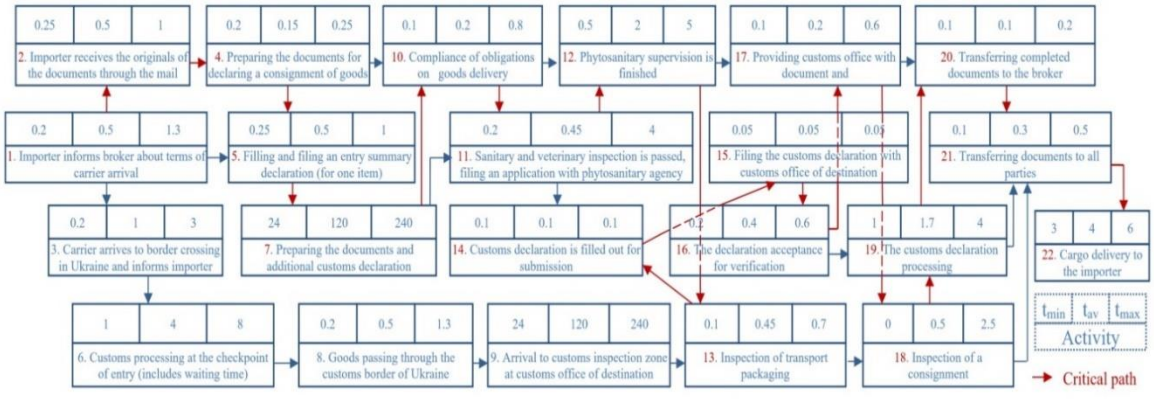

Figure 7. Simplified graph for customs clearance procedures in Ukraine: a case study.

If only a single form and single bill for services are submitted to specify the data necessary for different procedures related to phytosanitary inspection, then this value will be reduced by at least 2 hours.

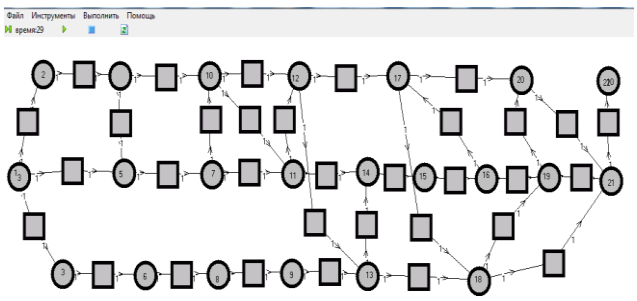

Figure 8. Petri net for modelling customs clearance procedures.

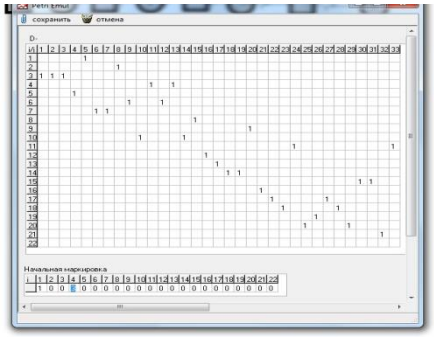

Figure 9. Matrix for Petri net.

Table 2. The data for generating input random numbers and calculating expected value of the whole process time duration (an extract from the research).

Variables of the graph	Distribution	A probability density function	Expected value	Standard deviation	Parameter k
…	…	…	…	…	…
6-1. Waiting time at the checkpoints, hours	Exponential	$f(t) = ke^{-kt}$	-	-	0,007
6-2. Time for customs processing at the checkpoints, hours	Normal (or Gauss)	$f(t) = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{(t-\bar{t})^2}{2\sigma^2}}$	0,67	+ - (0,2)	-
…	…	…	…	…	…

Another proposal of the focus group is to cancel a sale contract. The drafting takes a lot of time and efforts. When scrutinizing a declaration, the customs inspectors must read it, analyze it and make sure through payment documents that all of its provisions are met correctly. That slows down the customs clearance. Brokers must send scanned copies of the contract to all supervision agencies. Also it is necessary to provide a specification to the contract (which may not actually exist) for phytosanitary certificating. Banks constantly have problems regarding the interpretation and errors in contracts. Instead of a contract it is proposed an invoice.

A passenger declaration, filled out in advance and sent to customs authorities, for goods in accompanied/unaccompanied baggage or freight shipment can also significantly simplify procedures at a border crossing. For that purpose the Single Window system could be useful taking current technological horizons and digital mobility into account.

Also, one of the development trends for information and communication technologies could be the introduction of the well known "electronic reservation of a border queue place" technology, which significantly reduces the risk of delay at border crossings by booking a place in queue for a small fee. For today the coefficients of the variation of t standard deviation from the average waiting time at the border crossing points in Ukraine are rather high, indicating that the situation with regard to the queues is unpredictable. An electronic queue reservation will reduce the variation value from 40% to 10%, and the cargo owner will more accurately estimate the delivery time.

4. Discussion

Network planning of the procedure shows parallelism of the operations, which allows taking into account the significance of each improvement. Some improvements do not lie on the critical path and therefore they are not discussed in the article. Some considerations of experts were clarified during the survey; other comments were not taken into account, because of the difficulties to quantify their importance. Another round of focus-group survey is planned to revise the solutions. Since the operation time are only estimated regarding to 7

milestones of the process, further refinement is mapped out for both Single Window model and time characteristics of a wider set of operations with due account for potential risks.

5. Conclusions

Modern electronic systems and technologies can reduce the time for goods and documents to pass through customs. One of these systems is the Single Window, an electronic system for exchanging data at customs during import-export operations or transit, which is effectively used worldwide. The Singapore TradeNet system gives an electronic response about passing controls 10 minutes after filing documents. About 9 million submissions for trade permits are processed per year. PortNet is truly a multi-functional unified system in Finland for participants who deliver goods by sea. More than 99% of all forms for customs clearance of ship cargo are processed through the Single Window. In Ukraine, the Single Window system has not yet become so effective, but it has a number of advantages and, if finalized, it will lead to the development of international trade. Obviously, mobile applications and information resources comfort and facilitate our life, so new platforms, based on blockchain technology that make available various kinds of information for all participants of the delivery (including manufacturers, exporters, transporters, government agencies, importers and consumers), will provide an opportunity to analyze the situation and prevent errors.

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