Methods of Mathematical Logic of Modeling the Process of Customs Risk Management

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Abstract: The article examines the problem of improving the customs risk management system. Due to the fact that the customs risk management system belongs to the class of intelligent information systems, existing state standards in this area were analysed. The role of intelligent information systems in public administration is analysed and the problem of creating state standards for intelligent systems is outlined. The necessity of logical support for the risk management system, along with legal, mathematical, algorithmic, software and technical support, has been proven. A logical model for monitoring compliance with customs legislation requirements in terms of the customs value of foreign trade goods has been developed. A method for reducing the requirements of customs legislation to a logical truth table is proposed. The truth conditions for the application of the first, second and reserve methods for determining the customs value of foreign trade goods are obtained in the form of an explicit formula of mathematical logic. The results of the implementation of the obtained scientific results in the activities of the customs authorities of the Republic of Uzbekistan were discussed.

1 INTRODUCTION

More than 5 years have passed since the introduction of the Risk Management System (RMS) into the activities of the customs service of the Republic of Uzbekistan, and it continues to yield positive results. In particular, by the end of 2023, 917 risk profiles of the RMS were implemented, of which 365 profiles were in an active state. It was noted that as a result of the effective application of the RMS in the process of organizing customs control during 2022, a shortfall in customs payments to the state budget of more than 640 billion soums (equivalent to about $57 million) was prevented.

At the same time, the steady growth of foreign trade turnover leads to the emergence of new and new forms of customs risks, which requires constant improvement of the customs control system. To date, highly qualified foreign specialists, including World Bank experts, have been involved in improving the RMS, and during this pro-cess certain systemic problems of the RMS are identified.

It is known that the RMS belongs to the class of intelligent information systems, which are distinguished by the fact that they allow automating not only the processes of collecting and preparing data, but also the processes of making complex decisions (Pollack, G., 2011).

However, as studies show, despite the fact that more than 50 state standards have been adopted in the field of information technology (Uz DSt 2590:2012, Uz DSt 1987:2018), today there are no state standards for the creation and implementation of intelligent information systems. The main reason for this is that when developing standards for the creation of information systems, careful studies of their legal,

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mathematical, algorithmic, software and technical support were carried out and standards were created, but the need for their logical support remained out of sight. Intelligent information systems, in particular, intelligent information processing, certainly require the development of logical foundations of this process, logical connections between each element of the processed information.

Based on the above, the development of logical foundations for the process of creating intelligent information systems is an urgent task.

2 LOGICAL MODELING OF CUSTOMS LEGISLATION REQUIREMENTS ON THE CUSTOMS VALUE OF GOODS

To prove the need to develop logical support for the process of creating intelligent information systems, it is sufficient to analyze the problems of logical control of compliance with customs legislation requirements. Below, as an example, we consider the problem of logical control over the implementation of customs legislation requirements concerning the determination of the customs value of foreign trade goods.

It is known that an attempt to declare the customs value of foreign trade goods by artificially reducing it is one of the most well-known and widespread customs violations (Kudryavtsev O., Tamrazyan S., 2017). The main reason for this is that the amount of customs duties for imported goods directly depends on the customs value of the goods, and the lower its customs value, the less customs duties are received by the state budget (Mukhtorov I., Abduraxmonov T., Saidov A., 2024).

On this issue, Article 302 of the Customs Code of the Republic of Uzbekistan "Methods for Determining the Customs Value of Imported Goods" defines the following:

"Determination of the customs value of imported goods is carried out by applying the following methods:

by the transaction value of the imported goods;
by the transaction value of the identical goods;
by the transaction value of the similar goods;
based on the subtraction of the values;
based on the addition of the values;
reserve.

The main method for determining the customs value of imported goods is the method based on the transaction value of the imported goods.

In the event that the main method for determining the customs value of imported goods cannot be applied, the methods specified in paragraphs three through seven of part one of this article shall be applied sequentially. In this case, each subsequent method is applied if the customs value cannot be determined using the previous one. The methods of subtraction and addition of values can be applied in reverse order" (Customs Code, 2016).

The issue of modeling this requirement, enshrined in customs legislation, was studied by the authors of the study (Mavlonov A., Mukhtorov I., 2024). In this case, the task of monitoring the applicability of the reserve method for determining the customs value of goods is reduced to the task of checking whether the events listed in Table 1 below are "true" or "false."

Table 1: Table of truth of the requirements of customs legislation for determining the customs value of goods (6-method).

Contents of the legal requirement	requirements of customs legislation	Logical value of legal requirements
a declaration for customs clearance of imported goods has been submitted	Must be fulfilled	true
the main method for determining the customs value of imported goods is applicable	Must not be fulfilled	false
2- the method of determining the customs value of imported goods is applicable	Must not be fulfilled	false
3- the method of determining the customs value of imported goods is applicable	Must not be fulfilled	false
4- the method of determining the customs value of imported goods is applicable	Must not be fulfilled	false
5- the method of determining the customs value of imported goods is applicable	Must not be fulfilled	false

From this it is clear that the issue of monitoring compliance with legal requirements is directly a question of mathematical logic.

It is known that the main object of logic is a statement, the main task of which is to determine whether the statement is "true" or "false". The founder of logic, Aristotle, at one time dwelling on this issue, points out that “every affirmation or denial must be accepted as true or false.” (Aristotle, 1978).

Later, in the 17th century, the German scientist G. Leibniz introduced the "law of sufficiency of justification" into the science of logic and rules for expressing thoughts using mathematical notations (Leibnis G., 1984). This led to the mathematical formalization of the laws of logic.

However, it should be noted that the application of Leibniz's methods to the formalization of the requirements of legal acts remains a pressing task to this day. In particular, the author of the work (Gubich, M., 2016) asserts that “in order to overcome the crisis phenomena in modern jurisprudence, it is necessary to formalize legal information and adapt it to the exact sciences.”

Table 2 provides the corresponding designations that are necessary for formalizing the requirements of Article 302 of the Customs Code of the Republic of Uzbekistan using methods of mathematical logic.

Table 2: Mathematical notations of logical operations.

Designation of statements	Logical operation	Designation of logical operation	Result of a logical operation
A	Definition of the negation of statement A	⅂	if statement A is "true," then statement ⅂A is "false"
A and B	Determine the case when both statements A and B are "true" (multiplication of statements)	&	The expression A&B is "true" if and only if the statements A and B are "true" simultaneously
A and B	Determine the case when one of the statements A and B is "true" (the sum of the statements)	V	The expression AVB is "true" if one of the statements A or B is "true"

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If each of the “contents of the requirements of legislation” in Table 1 is designated as $A_1, A_2, A_3, A_4, A_5, A_6, A_7$ respectively, then we will obtain a logical model of control over the fulfillment of the requirements of Article 302 of the Customs Code of the Republic of Uzbekistan.

$$A = A_1 \& ⅂A_2 \& ⅂A_3 \& ⅂A_4 \& ⅂A_5 \& ⅂A_6 \& A_7 \qquad (1)$$

Using this model (1), one can easily check whether opinion A is "true" or "false". The requirements of Article 302 of the Customs Code will be met only if it is “true”. At the same time, formula (1) provides only a general condition for monitoring compliance with the above-mentioned legislative requirement. For a full modeling of the process of control of this requirement of customs legislation, it is necessary to develop similar mathematical logical conditions for each of the requirements of $A_1, A_2, A_3, A_4, A_5, A_6, A_7$ In particular, the question of when the second condition of the requirements of the legislation, i.e. requirement A_2, is met is answered by Article 306 of the same code as follows:

“The method based on the transaction value of imported goods cannot be used to determine the customs value if:

there are restrictions on the rights of use or disposal of the goods being assessed by the buyer, with the exception of restrictions established by law, or restrictions on the geographical region in which the goods may be resold, or restrictions that do not significantly affect the price of the goods;

the goods were imported into the customs territory under a transaction that does not have a value basis;

the sale or transaction price depends on compliance with conditions, the influence of which cannot be taken into account (barter agreements, contracts, for processing);

any part of the proceeds from the subsequent resale, use or disposal of the goods directly or indirectly passes to the seller and it is impossible to

make a corresponding adjustment to the cost of the goods in accordance with Article 304 of this Code;

the data used by the declarant or customs broker when determining the customs value of the goods is not supported by documents;

the parties to the transaction (buyer and seller) are interdependent persons, except in cases where their interdependence did not affect the price of the transaction, which must be proven by the declarant or customs broker."

For this article of the Customs Code, it is also possible to form the same table of "legislative requirements," as the table 1 given above. Such a table will look like this (table 3):

Table 3: Table of truth of the requirements of customs legislation for determining the customs value of goods (1-method).

Contents of the legal requirement	requirements of customs legislation	Logical value of legal requirements
there are restrictions on the rights of use or disposal of the goods being assessed by the buyer	Must be fulfilled	true
the goods were imported into the customs territory under a transaction that does not have a value basis	Must be fulfilled	true
the sale or transaction price depends on compliance with conditions, the influence of which cannot be taken into account (barter agreements, contracts, for processing)	Must be fulfilled	true
any portion of the proceeds from the subsequent resale, use or disposal of the goods directly or indirectly passes to the seller	Must be fulfilled	true
the data used by the declarant or customs broker in determining the customs value of the goods are confirmed by documents	Must not be fulfilled	false
the parties to the transaction (buyer and seller) are interdependent persons	Must be fulfilled	true

(author's development)

If we enter the designations $A_{21}, A_{22}, A_{23}, A_{24}, A_{25}, A_{26}$ respectively for each of the "contents of the requirements of the legislation" in the above table 1, we will obtain the following logical model of the process of monitoring the implementation of the requirements of Article 306 of the Customs Code.

$$A_2 = A_{21}\&A_{22}\&A_{23}\&A_{24}\&\neg A_{25}\&A_{26} \qquad (2)$$

Using this model (2), one can easily check whether opinion A is "true" or "false". The requirements of Article 306 of the Customs Code will be met only if it is "true

3 CONCLUSIONS

In conclusion, it should be noted that the RMS implemented in the activities of customs authorities belongs to the class of intelligent information systems, and in the process of its improvement, certain systemic problems were identified. In particular, despite the fact that numerous state standards have been adopted in the field of information technology, today there are no state standards for the creation and implementation of intelligent information systems.

For this reason, when creating intelligent information systems, along with their le-gal, mathematical, algorithmic, software and technical support, an urgent task is the creation of their logical support.

The logical support for control of customs legislation requirements, developed within the framework of this study, was implemented in practice and demonstrated its effectiveness. In particular, to date, more than 50 logical control profiles have been put into practice, and as a result of their application, in 2022, the shortfall in customs payments to the state budget of the Republic of Uzbekistan in the amount of 462.1 billion soums (equivalent to about $41.1 million) was prevented.

REFERENCES

Pollack, G., 2011. The book, Intelligent information systems. Chelyabinsk: Russia, Publishing center of SUSU.

Uz DSt 1987:2018. State standard. Information technology. Technical specifications for the creation of an information system. Tashkent.

Uz DSt 2590:2012. State standard. Information technology. Requirements for the integration and interaction of information systems of government agencies used in the framework of the formation of the national information system. Tashkent.

Kudryavtsev, O., Tamrazyan, S., 2017. Scientific article. Application of descriptive statistics methods in the analysis of customs risks. Scientific journal "Bulletin of the Financial University", Rostov-on-Don, Russia, No. 1.

Mukhtorov, I., Abduraxmonov, T., Saidov, A., 2024. Scientific article. Mathematical Model of Optimum Management of the Customs Control Process and Expert System for Ensuring Data Reliability. Scientific journal “Journal of Engineering Research and Sciyences”, Special Issue Computing, Engineering and Sciyences (SI-CES), Sheridan, Wyoming, USA. Vol., Iss. 1.

Customs Code of the Republic of Uzbekistan, 2016. Tashkent.

Mavlonov, A., Mukhtorov, I., 2024. Scientific article. Some problematic issues of digitalization of customs activities. *Scientific journal “Fundamental Research”,* Vol. II, No. 3.

Aristotle, 1978. The book, Works in four volumes. Vol. 2. Moscow.

Leibnis G., 1984. The book, Works in four volumes: T. 3 Moscow.

Gubich, M., 2016. Scientific article. Formalization of language of legal acts as means of increase in their efficiency. Scientific journal «Labour. Trade Union. Society», No 4. Minsk