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ISSUES REGARDING THE IMPLEMENTATION OF THE “TOLLING OPERATIONS” MODULE IN THE GOODS MOVEMENT MANAGEMENT SYSTEM UNDER THE CUSTOMS TERRITORY PROCESSING REGIME

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Abstract. This study examines the issues of improving the system for managing the movement of goods under the customs regime of processing within the customs territory. In particular, the possibilities of digitalizing tolling operations and managing them through a unified information system are analyzed. The research scientifically substantiates the opportunities for ensuring transparent monitoring of the movement of raw materials and finished products, improving resource efficiency, and automating customs control through the implementation of the “Tolling Operations” module. In addition, the study highlights the reduction of the human factor, the acceleration of data exchange processes, and the creation of additional conveniences for participants in foreign economic activity through the practical application of the module. The research findings are of significant importance for the digital transformation of customs administration and the optimization of logistics processes.

Keywords: tolling operations, processing within the customs territory, customs regime, movement of goods, digitalization, information system, automation, customs control, logistics, foreign economic activity, monitoring, resource efficiency.

Annotatsiya. Mazkur tadqiqot bojxona hududida qayta ishlash bojxona rejimi doirasida tovarlar harakatini boshqarish tizimini takomillashtirish masalalarini o'rganishga bag'ishlangan. Tadqiqotda tolling operatsiyalarini raqamlashtirish hamda ularni yagona axborot tizimi asosida boshqarish imkoniyatlari tahlil qilingan. Shuningdek, “Tolling Operations” modulini joriy etish orqali xomashyo va tayyor mahsulotlar harakatining shaffof monitoringini ta'minlash, resurslardan samarali foydalanish hamda bojxona nazoratini avtomatlashtirish imkoniyatlari ilmiy jihatdan asoslab berilgan. Modulning amaliy qo'llanilishi natijasida inson omilini kamaytirish, ma'lumot almashinuvi tezligini oshirish va tashqi iqtisodiy faoliyat ishtirokchilari uchun qulayliklar yaratish masalalari yoritilgan. Tadqiqot natijalari bojxona ma'murchiligini raqamli transformatsiya qilish va logistika jarayonlarini optimallashtirishda muhim ahamiyat kasb etadi.

Kalit so'zlar: tolling operatsiyalari, bojxona hududida qayta ishlash, bojxona rejimi, tovarlar harakati, raqamlashtirish, axborot tizimi, avtomatlashtirish, bojxona nazorati, logistika, tashqi iqtisodiy faoliyat, monitoring, resurs samaradorligi.

Аннотация. Данное исследование посвящено вопросам совершенствования системы управления движением товаров в таможенном режиме переработки на таможенной территории. В работе проанализированы возможности цифровизации толлинговых операций и их управления на основе единой информационной системы. Также научно обоснованы возможности обеспечения прозрачного мониторинга движения сырья и готовой продукции, эффективного использования ресурсов и автоматизации таможенного контроля посредством внедрения модуля «Tolling Operations». Освещены вопросы сокращения влияния человеческого фактора, ускорения обмена данными и создания дополнительных удобств для участников внешнеэкономической деятельности в результате практического внедрения модуля. Результаты исследования имеют важное значение для цифровой трансформации таможенного администрирования и оптимизации логистических процессов.

Ключевые слова: толлинговые операции, переработка на таможенной территории, таможенный режим, движение товаров, цифровизация, информационная система, автоматизация, таможенный контроль, логистика, внешнеэкономическая деятельность, мониторинг, эффективность ресурсов.

INTRODUCTION

The deepening of globalization processes in the global economy, the increasing volume of international trade, and the growing complexity of logistics chains necessitate the continuous improvement of customs administration systems. In this context, the effective management of operations carried out under the customs territory processing regime is becoming increasingly important for participants in foreign economic activity. In particular, ensuring transparency in the movement of raw materials and finished products, maintaining continuity of customs control, and accelerating data exchange processes are among the key priorities of modern customs administration.

At present, tolling operations are widely applied in manufacturing and processing activities, contributing to the efficient utilization of resources, reduction of production costs, and optimization of supply chains. At the same time, modern customs practices demonstrate the need for further enhancement of monitoring mechanisms related to such operations. In particular, the fragmentation of information flows, the significant involvement of manual processes, and the limited integration of information systems indicate the importance of introducing advanced digital solutions in this area.

In this regard, the implementation of the "Tolling Operations" module into the goods movement management system under the customs processing regime represents one of the important directions for improving customs administration. The proposed module will create opportunities for the digital tracking of goods movement, automated control at all operational stages, and the integration of databases into a unified information platform.

The aim of this study is to substantiate the organizational and economic mechanisms for implementing the "Tolling Operations" module in order to ensure the effective management of goods movement under the customs territory processing regime. To achieve this objective, the theoretical foundations of tolling operations are examined, existing practices are analyzed, and practical proposals aimed at further improving the system are developed.

LITERATURE REVIEW

The improvement of customs administration and the digitalization of foreign trade procedures have become one of the priority research areas in the context of global economic integration. In accordance with Decree of the President of the Republic of Uzbekistan 17.12.2025 "On measures to further simplify customs administration and foreign trade procedures and enhance their efficiency" № DP-250¹, particular attention is being paid to simplifying customs procedures and introducing modern digital mechanisms into customs control systems. These reforms are contributing to increasing transparency, improving operational efficiency, and strengthening the effectiveness of customs administration processes.

In this regard, international scholars such as Peter A.G. van Bergeijk, Maaïke Okano-Vijmans, and Jan Melissen emphasize that the integration of digital technologies into economic diplomacy and customs administration significantly enhances transparency and the efficiency of operational processes. Their scientific approaches highlight the importance of coordinated information exchange systems and effective management mechanisms in the development of international trade relations.

At the same time, Stephen Woolcock and Nicholas Bayne note that modern international economic relations require flexible and integrated decision-making mechanisms supported by advanced digital infrastructure. Furthermore, the theoretical approaches developed by Paul Krugman, Maurice Obstfeld, and Marc J. Melitz confirm that efficient logistics chains and transparent customs procedures play a crucial role in strengthening international competitiveness and ensuring sustainable economic development.

In addition, OECD studies conducted by Lall S. underline that developing countries can significantly improve industrial competitiveness through the implementation of innovative management technologies and integrated customs information systems. These scientific approaches demonstrate the growing importance of digital transformation processes in enhancing the efficiency of customs administration and foreign economic activity.

RESEARCH METHODOLOGY

In this study, comprehensive scientific approaches were applied to examine the implementation of the "Tolling Operations" module within the goods movement management system operating under the customs processing regime. The theoretical and methodological foundation of the research is based on scientific approaches in the fields of customs administration, logistics, and the digital economy, as well as international

1 Decree of The President of The Republic of Uzbekistan, 17.12.2025. № DP-250 <https://lex.uz/ru/docs/7934926>.

experience related to the management of goods movement within customs regimes.

During the research process, systematic analysis and comparative analysis methods were widely employed. In particular, the systematic analysis method made it possible to examine the process of managing the movement of goods under the customs territory processing regime as an integrated system and to identify the interrelationships among its structural components. At the same time, the comparative analysis method enabled the assessment of existing opportunities for further improvement through the comparison of national practices with the experience of foreign countries in organizing and managing tolling operations.

The application of these scientific methods contributed to a comprehensive evaluation of the organizational, economic, and functional aspects of implementing the “Tolling Operations” module and allowed the development of practical proposals aimed at improving the efficiency, transparency, and digital integration of customs administration processes.

ANALYSIS AND RESULTS

As a result of the conducted research, the organizational, economic, and functional aspects of implementing the “Tolling Operations” module into the goods movement management system under the customs territory processing regime were comprehensively substantiated. At the same time, these factors limit the opportunities for ensuring comprehensive monitoring of the movement of raw materials and finished products throughout the processing stages.

The research findings confirmed that the proposed “Tolling Operations” module creates broad opportunities for improving the efficiency and transparency of customs administration processes. In particular, the module ensures accurate control of resource consumption through the automated calculation of the ratio between raw materials and finished products. In addition, the generation of transaction data in real time significantly enhances the transparency, reliability, and operational speed of customs control procedures. Furthermore, the implementation of the module contributes to reducing administrative burdens for participants in foreign economic activity, improving the quality of services provided, and strengthening the effectiveness of digital customs management mechanisms (Table 1).

TABLE 1

THE “TOLLING OPERATIONS” MODULE CONSISTS OF THE FOLLOWING MAIN FUNCTIONAL BLOCKS²

No.	Block Name	Function
1.	Input	Entry of raw material, contract, and customs regime data
2.	Processing	Production stages, norms, and cost reporting
3.	Finished Product Accounting	Registration of finished products
4.	Logistics & Movement	Control of incoming, outgoing, warehouse, and transport operations
5.	Control Panel	Real-time monitoring and status tracking
6.	Reporting and Analysis	Automated reporting and analytical processing
7.	Risk Management	Detection of suspicious transactions

Table 1 systematically presents the architecture and functional composition of the “Tolling Operations” module, which is regarded as an integrated management solution consisting of seven interconnected functional blocks. In particular, the module is designed to ensure digital control, transparency, and effective monitoring of the movement of goods under the customs territory processing regime.

The first functional block, “Input,” serves as the initial stage of the system. At this stage, all information related to raw materials, foreign economic contracts, and the applied customs regime is entered into the unified database. This information forms the primary data foundation for all subsequent operational processes.

The second block, “Processing,” is intended for the digital modeling and management of production stages. Technological operations, consumption norms, and cost reporting processes are maintained within this block, thereby ensuring comprehensive control over the transformation of raw materials into finished products.

The third block, “Finished Product Accounting,” provides for the registration and accounting of products obtained through processing operations. This creates opportunities for generating accurate and reliable information regarding the volume, type, and quality of finished products.

² Created by author.

The fourth block, "Logistics and Movement," is responsible for monitoring the receipt and dispatch of goods, warehouse operations, and transportation processes. Through this mechanism, all operations within the logistics chain are coordinated and managed within a unified digital environment.

The fifth block, the "Control Panel," enables real-time monitoring and visualization of operational processes. Through this panel, users can promptly track the status of transactions, operational changes, and system performance indicators.

The sixth block, "Reporting and Analysis," automatically generates analytical data and operational reports, thereby supporting effective decision-making processes and improving management efficiency.

The seventh block, "Risk Management," is aimed at the early identification of suspicious or potentially inappropriate transactions within the system. Through this mechanism, risk detection capabilities are strengthened and the overall efficiency of customs control is significantly enhanced.

Overall, the "Tolling Operations" module provides broad opportunities for the comprehensive digitalization, control, and analytical management of tolling operations through the seamless integration of all functional blocks. As a result, the module contributes to raising customs administration and logistics management processes to a qualitatively new level (Table 2).

Table 2
Basic performance schedule³

Stage	Incoming Data	Process	Output Result	Control
1.	Raw Material Inflow	Customs clearance	Registered resources	Automated control
2.	Production	Processing operations	Semi-finished products	System control
3.	Finished Product	Automated calculation	Volume of finished products	AI-based review
4.	Export / Output	Customs declaration	Outgoing goods	Customs control
5.	Analysis	Integrated data	Analytical report	Automated control

Table 2 presents the main operational algorithm of the "Tolling Operations" module as a consistent step-by-step process covering all stages from initial data entry to the generation of final analytical results. The table clearly reflects the operational logic of the system and the integrated control mechanisms applied at each stage of the process.

The first stage, "Raw Material Inflow," involves the customs clearance and registration of raw materials in accordance with established procedures. As a result, the registered resources are entered into the unified information system. This process is performed through automated control mechanisms, which significantly reduce the influence of the human factor and improve operational accuracy.

The second stage, "Production," involves directing the input raw materials to technological processing operations. At this stage, production processes are digitally managed under continuous system supervision, resulting in the generation of semi-finished products and ensuring operational consistency throughout the processing cycle.

The third stage, "Finished Product," is focused on the automated calculation and verification of the volume and quality of finished products through artificial intelligence-based analytical mechanisms. This approach ensures the reliability, precision, and consistency of operational calculations and control procedures.

The fourth stage, "Export/Output," involves the release of finished products from the system based on customs declarations. During this stage, the movement of goods is monitored under the supervision of customs authorities, and all outgoing products are digitally recorded within the integrated system.

The fifth stage, "Analysis," provides for the generation of final analytical reports based on the comprehensive data collected throughout all operational stages. This process is fully automated and serves as an effective mechanism for supporting analytical evaluation and managerial decision-making.

Overall, the table demonstrates the complete operational chain of the "Tolling Operations" module, beginning with data entry and ending with analytical reporting, while ensuring transparency, efficiency, and reliability through the application of automated and intelligent control systems at every stage. One of the primary advantages of this algorithm is that tolling operations are managed according to the end-to-end digital management principle within a single integrated information system rather than through separate fragmented modules. This approach eliminates repetitive data entry, minimizes operational errors, and ensures the continuity and synchronization of all business processes.

In addition, the control mechanisms integrated into the system are based on a multi-layered approach that combines automated verification, artificial intelligence-based analysis, and direct customs supervision. Such an

³ Created by author.

integrated control model significantly expands opportunities for early risk detection, prevention of unauthorized operations, and more efficient utilization of resources.

As a result, the “Tolling Operations” module functions not only as an operational management tool but also as an advanced analytical platform that supports strategic decision-making processes. Consequently, the implementation of this module contributes to deepening the digital transformation of the national customs system, strengthening transparency, and enhancing competitiveness within international logistics chains (Figure 1).

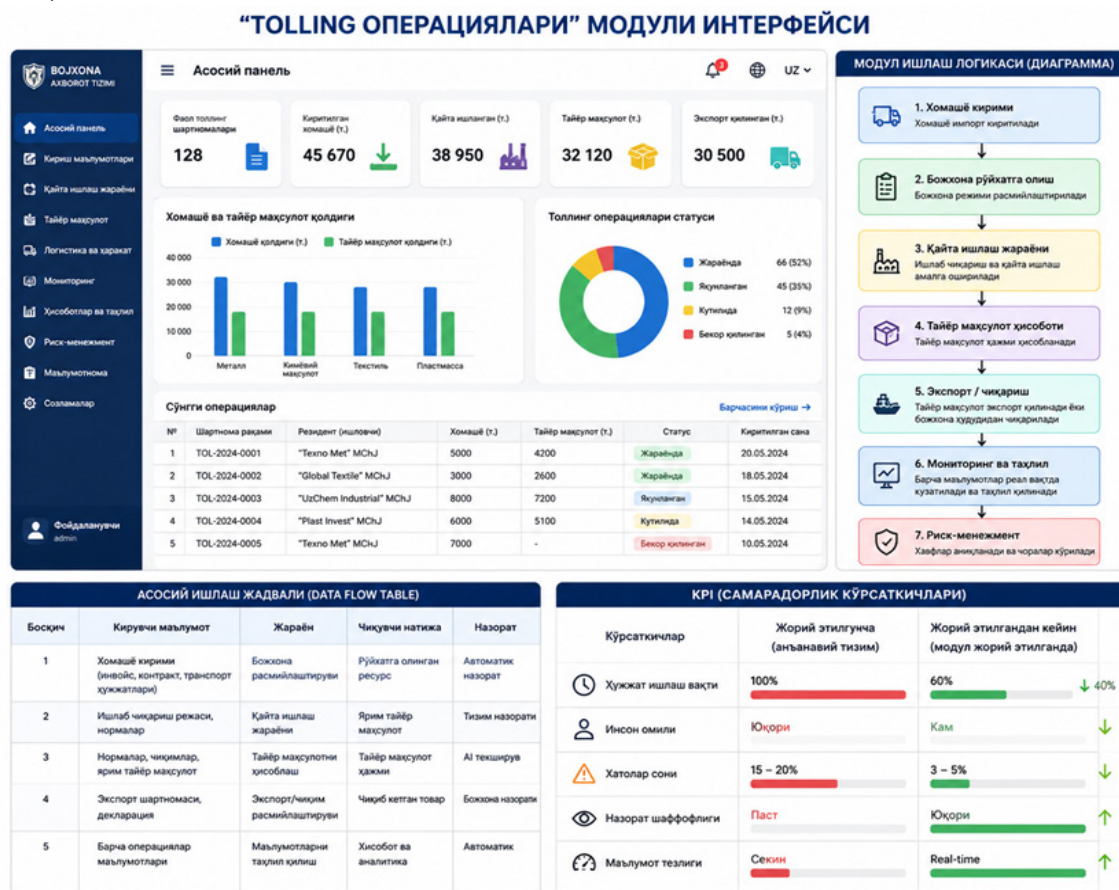


Figure 1. Interface of the Tolling Operations Module

During the research process, the functional architecture of the “Tolling Operations” module was also developed and scientifically substantiated. In particular, it was determined that the data collection, processing, analysis, and monitoring blocks operate within a mutually integrated digital environment. Such integration contributes to the formation of a unified ecosystem of customs information systems and enhances the efficiency of operational management processes.

The research findings demonstrate that the implementation of the “Tolling Operations” module is of significant practical importance for the digitalization of customs administration, the optimization of logistics processes, and the effective management of goods movement. The study results further indicate that the efficient management of tolling operations within the customs territory processing regime is closely connected with ongoing digital transformation processes. Under modern conditions, the limited effectiveness of traditional methods used for controlling the movement of goods, particularly delays in data processing and inaccuracies associated with the human factor, highlights the necessity of introducing innovative and technology-based approaches in this field.

In this regard, the “Tolling Operations” module proposed within the study is evaluated as an innovative and effective solution aimed at improving existing operational mechanisms. In particular, the centralized maintenance and real-time updating of data through the module significantly enhance the efficiency, transparency, and reliability of customs control procedures. At the same time, the module creates opportunities for tracking the movement of goods at every operational stage, monitoring their status during processing, and identifying potential risks at an early stage.

Furthermore, the analysis of international experience demonstrates that the digitalization of tolling

operations contributes to ensuring the transparency, continuity, and consistency of logistics chains. In several developed countries, the integration of information systems has enabled a high degree of automation in customs processes, thereby creating favorable conditions for participants in foreign economic activity and improving the quality of customs services. In this context, the gradual adaptation of such advanced practices into national customs administration is considered highly beneficial.

At the same time, the implementation of the “Tolling Operations” module may involve certain organizational and technical challenges. In particular, the insufficient development of technical infrastructure for system integration, the need to strengthen data security mechanisms, and the limited availability of highly qualified specialists may affect the efficiency of implementation processes. Therefore, the successful introduction of the module requires a comprehensive approach based on the harmonization of technical, organizational, and legal mechanisms.

From this perspective, the research results confirm that the implementation of digital solutions in the customs system contributes not only to strengthening control functions but also to improving service quality, simplifying business procedures, and increasing the overall efficiency of customs administration. Consequently, the practical implementation of the “Tolling Operations” module can be regarded as one of the important stages in the modernization and digital transformation of the national customs system.

CONCLUSIONS AND RECOMMENDATIONS

The results of the conducted research demonstrate that the implementation of digital technologies plays a decisive role in ensuring the effective management of goods movement under the customs territory processing regime. In particular, the management of tolling operations through a unified information system contributes to strengthening transparency in the movement of goods, ensuring continuity of customs control, and increasing the speed and reliability of data exchange processes.

The implementation of this module will also contribute significantly to the digital transformation of customs administration, the optimization of logistics processes, and the creation of a more favorable and transparent business environment for participants in foreign economic activity. At the same time, the research findings made it possible to develop several practical proposals aimed at further improving customs administration processes. In particular, it is considered important to develop and implement a unified digital module covering all operational stages within the customs processing regime, as well as to establish an integrated information platform ensuring effective data exchange among customs authorities, tax institutions, logistics centers, and participants in foreign economic activity.

Furthermore, the study substantiates the importance of introducing modern mechanisms that enable real-time monitoring of the movement of raw materials and finished products, thereby increasing the overall efficiency, transparency, and reliability of customs control procedures. Consequently, the practical implementation of the “Tolling Operations” module can serve as an important factor in strengthening digital customs infrastructure and enhancing the competitiveness of national logistics and foreign trade systems.

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