

The impact of digitalization on physical customs control, by evaluating the use of non-destructive scanners and artificial intelligence-based systems

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Abstract. *Digitization, digitalization and digital transformation are important concepts for current economic dynamics. Many public institutions have digitized all their activities and the entire system flows, but some organizations are still working on this aspect. In the customs system, most activities are positioned in the digitalization activity. Steps are also being taken for digital transformation and artificial intelligence is used for physical control. This research initially aims to identify variables that have a significant relationship with organizational digitalization and then what are the factors that influence these variables. The results indicate a robust positive association between digitalization and technological advancement, as well as fraud dynamics. However, digital transformation is associated with major investments. The second step was to determine the factors that influence these variables. The main limitations refer to the application of the research at the Romanian level.*

Keywords: Strategy, management, digitalization, sustainability, artificial intelligence, monitoring.

Introduction

Digitization is the first process for digital transformation. Digitalization is important for all organizations. This process is not possible without digitalization. The next step is digital transformation, which involves the use of digital tools that contribute to the transformation of an organization into a competitive, environmentally friendly, efficient, sustainable one that creates value for stakeholders (Leigh Monton, 2022; Pislariu et al., 2008; Savic, 2019).

At the national level, there is the Multiannual Program for the Modernization and Development of Customs Infrastructure (P.M.M.D.I.V.) The Government of Romania approved, at the proposal of the Ministry of Finance and the Romanian Customs Authority (RCA), the Multiannual Program for the Modernization and Development of Customs Infrastructure (P.M.M.D.I.V.). Carried out during the period 2025-2030, this program aims to improve the administrative and operational capacity of the Romanian Customs Authority. An essential aspect of the program is the transition of customs clearance activity to a fully electronic environment, thus simplifying customs formalities and reducing bureaucracy. The program also aims to modernize customs points and equip them with state-of-the-art equipment, contributing to securing borders and effectively combating tax evasion. Starting with 2024, companies carrying out export activities in Romania are required to use electronic signatures to carry out customs formalities. This measure is part of the efforts to modernize the Romanian Customs Authority's IT systems and aims to shorten document verification times, simplify procedures and allow online uploading of documentation related to customs operations (Borysenko et al., 2022; Fedotov & Zotenko, 2020; Medin, 2021). The decision is in accordance with the provisions of Government Emergency Ordinance no. 38/2020, which obliges public authorities and institutions to accept electronic documents transmitted by natural and legal people. In addition to the digital signature, RCA uses a series of digital tools that contribute to increasing security and easier identification of risks.

Although significant progress has been made in the digitalisation of the customs system, there are still challenges to be addressed. One of these is ensuring interoperability between the different national and European IT systems, to facilitate the exchange of information and harmonise customs procedures. Continuous training of customs staff is also essential to adapt to new technologies and to make effective use of the available digital tools (Bhatta et al., 2023; Pislaru et al., 2011). Investments in infrastructure and cybersecurity are also crucial to protect sensitive data and prevent potential cyber-attacks (Endrodi-Kovács & Stukovszky, 2022; Korhonen et al., 2021; Tilley, 2023). Therefore, digitalisation and continued investment in technology, staff training, together with close collaboration with European partners, will be essential for the long-term success of these initiatives (Busu, 2021; Cioca et al., 2019; Ivascu et al., 2015, 2021).

The present research is structured into two parts. The first part includes the presentation of the Romanian customs system from the perspective of digitalization and digital transformation, and the second part includes market research conducted with RCA employees, using a considerable sample. The research answers the two questions:

"Is the Romanian customs system digitalized?"

"Are employees prepared for new technologies?"

Digitalization of the customs system in Romania

The digitization process in the customs system began with Romania's accession to the European Union, implementing the Customs Information System (SIV) and Commodity Declaration Information System (RCDPS), encompassing the final operations such as import and export, processed at customs offices. Processing the import customs declaration represents a first procedure for taking over existing data both in the information system and on paper, thus maintaining a double record of documents, followed by confirmation, presentation of goods and centralized customs clearance.

The process of digitizing the customs system involves the use of an advanced infrastructure, based on both specialized software and artificial intelligence, which was implemented on March 16, 2024, replacing the Export Control System (ECS-RO). Automated export system (AES-RO) manages export and re-export customs declarations, as well as exit notifications. The New Computerized Transit System (NCTS5-RO) is applicable to goods passing through customs. It acts like an application that helps authorities track and manage shipments in a faster and more secure way, reducing waiting times. DVSRD WEB is an essential component of the modern customs system, specially designed for the processing of simplified customs declarations H7. This system plays a crucial role in facilitating and securing e-commerce, ensuring a fast and efficient customs clearance process for low-value shipments from non-EU countries. By automating and optimizing the data flow, DVSRD WEB contributes to accelerating customs operations, reducing waiting times for customs declaration processing, reducing errors and improving compliance with international regulations. By eliminating physical (paper) records and endless queues, carriers can send all the necessary data electronically, and the system processes them instantly. This means that goods arrive at their destination faster, and companies save time and money. In addition, being connected to European customs networks, NCTS5-RO allows for more efficient collaboration between authorities in different countries, preventing fraud and ensuring safer and more transparent trade.

The equipment used includes:

- Intranet-connected computers and tablets, which allow secure access to centralized databases and customs management applications.

- Video cameras and automatic number plate recognition (ANPR) systems, used to detect registered vehicles or monitor transport flows.
- Mobile and fixed scanners for non-destructive physical control, which allow rapid verification of the contents of containers and vehicles, reducing the need for physical customs controls.
- Transceiver stations and secure communications equipment, which ensure the rapid exchange of information between customs inspectors in the field and coordination centers.
- Artificial intelligence systems and advanced data analysis, which allow the identification of fraud patterns and risks associated with the transport of goods.

For the integration of information technology (IT) systems and the optimization of controls, an essential element of digitalization is the interconnection of IT systems, which allows a rapid flow of information between different authorities and customs inspectors. Through common databases and information exchange platforms, it is ensured:

- Instant verification of customs documents and transport history, which reduces the risk of fraud and smuggling.
- Predictive risk analysis, through which suspicious goods can be identified before they reach the border.
- Real-time monitoring of cross-border traffic, using ANPR cameras and smart sensors.

With these solutions, customs controls become more efficient, and the processing time of goods and people is considerably reduced. Big data and artificial intelligence are important for customs activity because the volume of data is very large. The connection between the two concepts is shown in Figure 1.

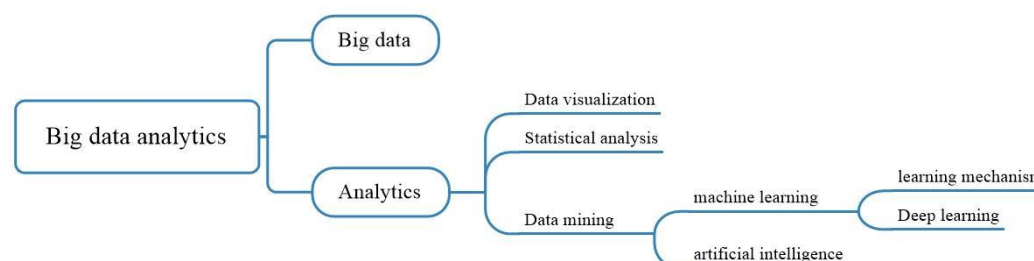


Figure 1. Big data analytics and artificial intelligence

The operations of the customs system are numerous, complex and complex data. For example, evaluating the verification stages of a customs declaration (CD), it can be seen that it involves at least 13 operations that involve a high volume of data. These operations are presented in Figure 2.

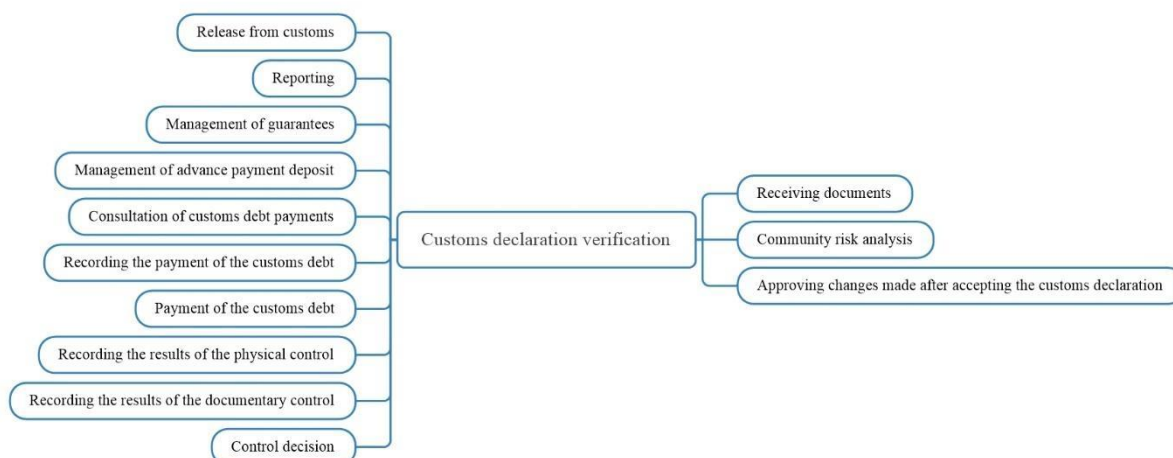


Figure 2. The activities of custom declaration verification

In situations where discrepancies or inconsistencies are found between the data entered in the declaration and physical control, a series of additional actions can be requested, presented in Figure 3.

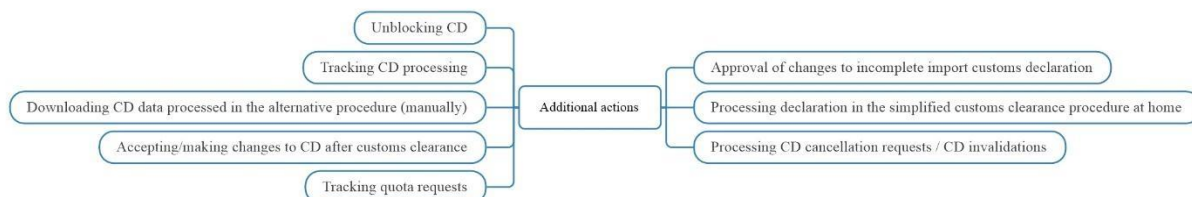


Figure 3. The additional action for custom declaration verification

Although digitalization offers multiple advantages, its full implementation requires significant investments in infrastructure, cybersecurity and staff training. The main challenges identified include:

- The need for a robust IT infrastructure, capable of handling large volumes of data in real time.
- Protection against cyberattacks, given that digitalized systems become targets for hackers.
- Resistance to change on the part of staff, which requires training programs and adaptation to new technologies.
- Alignment with international standards, to facilitate interoperability with customs systems in other countries.

Through an evaluation of the Romanian Customs Authority, based on the author's empirical experience, the latest steps taken in its equipment were identified. Among this equipment are license plate recognition cameras, for the rapid identification of vehicles in the database; fixed and mobile transceiver stations, which facilitate efficient communication between agents; laptops and integrated printers connected to the intranet, for rapid access to documents and databases. This equipment allows the instantaneous transmission and processing of information, increasing the monitoring and intervention capacity. Through this modernization,

the Romanian Customs Authority improves its operational capacity, reduces fraud risks and optimizes control processes.

Other studies show that innovation, infrastructure and education are very important for the digitalization of customs and other organizations. Another study shows that employee engagement and the absence of barriers will contribute to digital transformation.

Methodology

For the present research, an online questionnaire was applied to 390 employees in the customs system. Of these responses, 350 were validated and considered for analysis. The research period was September 2024 - January 2025. Statistical software was used to perform correlation tests and regression analysis. The main results are presented in the following section.

Results and discussions

This section includes the main results obtained from the market research. Table 1 presents the distribution of the 350 respondents whose answers were validated. It can be seen that a significant sample consists of employees with over 15 years of experience. Of these, 200 respondents are over 35 years old. A significant sample is that of work experience between 10 and 15 years.

Table 1. Period of employment in the Romanian Customs Authority of the respondent

Category			Frequency	Percent	Valid Percent	Cumulative Percent
>15 years	Valid	>56 years	150	59.06	59.06	59.06
		36-45 years	50	19.69	19.69	78.74
		46-55 years	54	21.26	21.26	100
		Total	254	100.0	100.0	100.0
1-5 years	Valid	>56 years	3	8.6	8.6	8.6
		18-25 years	1	2.9	2.9	11.4
		26-35 years	8	22.9	22.9	34.3
		36-45 years	9	25.7	25.7	60.0
		46-55 years	14	40.0	40.0	100.0
		Total	35	100.0	100.0	100.0
10-15 years	Valid	26-35 years	40	85.11	85.11	85.11
		36-45 years	1	2.13	2.13	87.24
		46-55 years	6	12.77	12.77	100.0
		Total	47	100.0	100.0	100.0
5-10 years	Valid	>56 years	1	9.1	9.1	9.1
		26-35 years	3	27.3	27.3	36.4
		36-45 years	3	27.3	27.3	63.6

		46-55 years	4	36.4	36.4	100.0
		Total	11	100.0	100.0	100.0
<1 years	Valid	36-45 years	2	66.7	66.7	66.7
		46-55 years	1	33.3	33.3	100.0
		Total	3	100.0	100.0	100.0

Source: Author' own research

The research began with identifying correlations between the research topic and indicators that can contribute to the digitalization of organizations in the customs system. Correlations are significant if they are at the 0.01 level. It can be seen that digital infrastructure, digital applications, education and development facilities have a significant relationship with digitalization. The values obtained were .672, .511, .589, and .789, Table 2.

Table 2. Correlation Digitalisation with support organizational variables

Correlations							
			Digitalisation (D)	Digital infrastructure	Digital application	Employee education	Digital development facilities
Kendall's tau_b	D	Correlation Coefficient	1	.672**	.511*	.589**	.789**
		Sig. (2-tailed)		0	0,038	0,029	0,003
		N	22	24	18	18	18

** . Correlation is significant at the 0.01 level (2-tailed); * . Correlation is significant at the 0.05 level (2-tailed).

Source: Author' own research

The results obtained also show a negative correlation between digitalization and remuneration. This aspect would mean that increasing employee remuneration would lead to improving the digitalization of the organization. However, this is not possible because investments in digitalization are made at the level of the customs system and employees can be educated and supported to acquire new skills. The rest of the correlations are relevant, which means that digitalization is relevant in the context of a competitive team, a safe working environment and professional equipment that is used in the use of technologies and infrastructure, Table 3.

Table 3. Correlation Digitalisation with motivation variables

Correlations							
			Digitalisation (D)	Remuneration	Team	Environment	Employee's professional equipment
Kendall's tau_b	D	Correlation Coefficient	1	-.369**	.456*	.671**	.656**
		Sig. (2-tailed)		0.019	0.006	0.024	0.0031

		N	22	24	18	18	18
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**. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed).

Source: Author' own research

Table 4, investigates the correlation between digitalization and innovation. It can be seen that there is a strong correlation between digitalization and innovation, customs strategy, and process data and analytics.

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Table 4. Correlation digitalisation with innovation

Correlations							
			Digitalisation (D)	Innovation	Customs strategy	Process	Data&Analytics
Kendall's tau_b	D	Correlation Coefficient	1	.612**	.386*	.564**	.612**
		Sig. (2-tailed)		0.021	0.037	0.028	0.031
		N	22	24	18	18	18

Source: Author' own research

In addition, a regression analysis was conducted between digitalization and organizational performance. The way we determined the correlation was through a linear regression analysis. We identified a significant positive relationship between these factors. In other words, the more an organization in this system is digitalized, the more it will become performing and achieve its developed strategy and culture. The result may indicate that the more an organization is involved in the digitalization and digital transformation system, the more innovative it will be and its position in the organizational system will increase, Table 5.

Table 5. Regression Analysis: Digitalisation and Organizational performance variables

Model	Unstandardized Coefficient		Standardized Coefficients	t	Sig
	B	Std. Error	Beta		
Constant	13.111	2.511		4.423	.000
	3.534	.548	.276	5.389	.000
Dependent Variable: Digitalisation					

Source: Author' own research

Table 6 presents all the variables that can contribute to the smooth development of the organization's digitalization. Thus, the previously investigated variables were considered: innovation, customs strategy, process, data and analysis, remuneration, team, environment, and employee's professional equipment. It can be seen that remuneration is very important for almost all respondents, while data analysis and processes are perceived differently by the 350 validated respondents.

Table 6. Evaluation of variables that contribute to the development of the organization

	1 (not important)	2	3	4	5 (very important)
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Innovation	1	4	5	280	60
Customs strategy	10	20	45	134	141
Process	23	34	57	87	149
Data & Analytics	12	23	112	56	147
Remuneration	0	0	0	11	339
Team	3	12	34	211	90
Environment	2	45	76	166	61
Employee's professional equipment	0	0	67	78	205

Conclusion

The digitalization of the customs system is an essential step towards increasing the efficiency and security of border control operations. Although the full implementation of these technologies requires major investments and overcoming significant challenges, the benefits brought – reducing verification time, combating fraud and improving the flow of information – justify this effort. Modernizing the infrastructure and integrating digital solutions are essential for aligning with international standards and adapting to the new realities of global trade.

In recent years, the Romanian customs system has undergone an extensive digitalization process, with the main goal of streamlining and modernizing customs procedures. This approach was essential for aligning with European standards and facilitating international trade.

The study shows that digitalization is a concern for the customs system. It uses a series of AI facilities and manages to strengthen the level of national security. Among the important elements are updated infrastructure, machine learning and big data. The elements that motivate the employees to use the latest technologies are education, remuneration, salary increases and the team they are part of.

The main limitations refer to the application of the research at the Romanian level.

References

- Bhatta, D. D., Sarfraz, M., Ivascu, L., & Pislaru, M. (2023). The Nexus of Corporate Affinity for Technology and Firm Sustainable Performance in the Era of Digitalization: A Mediated Model. *Sustainability (Switzerland)*, 15(12), <https://doi.org/10.3390/su15129765>
- Borysenko, O., Vasylyeva, O., Katerna, O., Masiuk, I., & Panakhi, O. (2022). Modeling the Risks of the Global Customs Space. *Journal of Risk and Financial Management*, 15(12), <https://doi.org/10.3390/jrfm15120598>
- Busu, M. (2021). Digital Economy and New Value Creation represents the theme of the International Conference on Business Excellence (ICBE), The 15th Edition, March 18-19, 2021. *Proceedings of the International Conference on Business Excellence*, 15(1), <https://doi.org/10.2478/picbe-2021-0003>
- Cioca, L. I., Ivascu, L., Turi, A., Artene, A., & Gaman, G. A. (2019). Sustainable development model for the automotive industry. *Sustainability (Switzerland)*, 11(22), <https://doi.org/10.3390/su11226447>
- Endrodi-Kovács, V., & Stukovszky, T. (2022). The adoption of industry 4.0 and digitalisation of Hungarian SMEs. *Society and Economy*, 44(1), <https://doi.org/10.1556/204.2021.00024>
- Fedotov, O., & Zotenko, O. (2020). Risk management in customs inspection of goods. *Lex Portus*, 3(23). <https://doi.org/10.26886/2524-101X.3.2020.5>

- Ivascu, L., Mocan, M., Draghici, A., Turi, A., & Rus, S. (2015). Modeling the Green Supply Chain in the Context of Sustainable Development. *Procedia Economics and Finance*, 26, [https://doi.org/10.1016/s2212-5671\(15\)00819-9](https://doi.org/10.1016/s2212-5671(15)00819-9)
- Ivascu, L., Sarfraz, M., Mohsin, M., Naseem, S., & Ozturk, I. (2021). The causes of occupational accidents and injuries in romanian firms: An application of the Johannsen cointegration and granger causality test. *International Journal of Environmental Research and Public Health*, 18(14), <https://doi.org/10.3390/ijerph18147634>
- Korhonen, T., Juurola, L., Salo, L., & Airaksinen, J. (2021). Digitisation or digitalisation: Diverse practices of the distance education period in finland. *Center for Educational Policy Studies Journal*, 11, <https://doi.org/10.26529/cepsj.1125>
- Leigh Monton, A. (2022). *Difference and Similarities: Digitization, Digitalization, and Digital Transformation*. GlobalSign.
- Medin, H. (2021). Customs brokers as intermediaries in international trade. *Review of World Economics*, 157(2). <https://doi.org/10.1007/s10290-020-00396-w>
- Pislaru, M., Avasilcăi, S., & Trandabăt, A. (2008). Environmental sustainability based on fuzzy models. *Environmental Engineering and Management Journal*, 7(1). <https://doi.org/10.30638/eemj.2008.005>
- Pislaru, M., Trandabăt, A., & Avasilcăi, S. (2011). Neuro-fuzzy model for environmental impact assessment. *Environmental Engineering and Management Journal*, 10(3), 381–386. <https://doi.org/10.30638/eemj.2011.055>
- Savic, D. (2019). From Digitization, Through Digitalization, Digital Transformation. In *Online Searcher*, vol. 43 (1).
- Tilley, K. (2023). Digitisation VS Digitalisation. *Manufacturing Management*, 2023(3–4). [https://doi.org/10.12968/s2514-9768\(23\)90389-3](https://doi.org/10.12968/s2514-9768(23)90389-3)