



# Institutional Theory and Digital Maturity – A Framework for Analysing the Digital Transformation of the Transport Sector

Ana ŠEGO<sup>1</sup>, Maja GAKIĆ<sup>2</sup>, Mario ŠAKIĆ<sup>3</sup>

Original Scientific Paper  
Submitted: 3 Oct 2025  
Accepted: 11 Feb 2026  
Published: 29 June 2026

<sup>1</sup> ana.sego1@phd.sum.ba, Department of Management in Digital Environment, University of Mostar, Mostar, Bosnia and Herzegovina

<sup>2</sup> mgakic@phd.sum.ba, Department of Management in Digital Environment, University of Mostar, Mostar, Bosnia and Herzegovina

<sup>3</sup> mr.sakic@gmail.com, Department of Traffic, College “Logos Centar”, Mostar, Bosnia and Herzegovina



This work is licensed under a Creative Commons Attribution 4.0 International Licence.

Publisher:  
Faculty of Transport and Traffic Sciences,  
University of Zagreb

## ABSTRACT

This paper analyses the digitalisation of the transport sector in Bosnia and Herzegovina through the theoretical frameworks of institutional theory, the resource-based view (RBV) and the concept of digital maturity. The study, conducted on a sample of 85 transport companies, aimed to examine the role of institutional pressures and internal capacities in the implementation of digital technologies, with particular emphasis on smart tachographs as a key regulatory and technological driver of digital transformation. Smart tachographs, together with telematics and navigation systems, are considered indicators of the digital maturity level of transport companies. The results show that legislation remains the main driver of digitalisation, supporting institutional theory, while companies with higher levels of digital maturity are more likely to recognise strategic benefits such as efficiency improvements, data-driven decision-making and advanced analytics. The findings also suggest that the intensive use of tachograph and telematics data contributes to the development of organisational competencies that represent valuable and hard-to-imitate resources, consistent with RBV. The paper contributes by linking institutional pressures and digital maturity and by introducing the concept of the “digital stack”, while the practical implications highlight the need to strengthen internal digital capacities beyond regulatory compliance.

## KEYWORDS

digital transformation; smart tachographs; digital maturity; institutional theory; resource-based view (RBV).

## 1. INTRODUCTION

Digitalisation is one of the key trends in today’s economy and strongly influences the transformation of all sectors, including transport. The increased complexity of global supply chains, requirements for safety and sustainability, and the rapid development of digital technologies are shaping a new business environment in which competitiveness is increasingly based on the use of data and digital tools. The transport sector in the European Union, but also beyond, is at the heart of these processes through regulations that promote standardisation, transparency and safety, among which the introduction of digital and smart tachographs plays a particularly important role. In Bosnia and Herzegovina, the process of digitalisation of the transport sector is taking place in parallel with the alignment of domestic regulations with European legislation. This paper is primarily an empirical study with an explanatory and theory-building orientation. Using survey data from transport companies, the study empirically examines how institutional pressures and internal digital capacities shape digital maturity in the transport sector. Although there have been significant advances in the implementation of digital solutions, research analysing the actual effects of regulations and the level of digital

maturity of companies in this area is still scarce. Previous findings on digital transformation show that most companies are only just entering this process and that there is a significant gap between the awareness of the importance of digitalisation and the actual implementation of advanced technologies [1]. The specific area of the transport sector has not yet been analysed in greater detail, which opens up space for examining institutional pressures and digital maturity in this context, as well as for a deeper understanding of the dynamics of digital transformation within the institutional and economic framework of Bosnia and Herzegovina. In this paper, we distinguish between digitalisation, understood as the introduction of individual technologies (e.g. smart tachographs, telematics, navigation systems), and digital transformation, which encompasses a broader process of strategic and organisational changes [2]. The empirical part of the study focuses on measuring the processes of digitalisation, while the theoretical framework interprets how these processes operate within the broader transformation. The aim is to examine the role of institutional pressures and digital maturity in the digitalisation of the transport sector in Bosnia and Herzegovina, with a particular emphasis on the implementation of smart tachographs. Bosnia and Herzegovina is a signatory to the AETR (European Agreement concerning the Work of Crews of Vehicles Engaged in International Road Transport), and the installation of smart tachographs for vehicles from Bosnia and Herzegovina remains insufficiently clearly defined in international transport within EU member states. That is why companies approach their implementation primarily due to regulatory uncertainty, which makes this process particularly relevant for the analysis of institutional pressures. This paper contributes to the existing literature and practice on three levels. First, the theoretical contribution lies in the integration of institutional theory, the resource-based view (RBV) and the concept of digital maturity into a single framework for analysing the digitalisation of the transport sector. Second, the methodological contribution stems from empirical research conducted on a sample of transport companies in Bosnia and Herzegovina, thereby addressing a gap in studies of this specific sector and institutional context. Third, the practical contribution is reflected in the introduction of the “digital stack” concept, which provides managers and policymakers with a structure for understanding how regulatorily mandated technologies, such as smart tachographs, can be transformed into a strategic resource and a long-term source of competitive advantage. In this way, the paper enhances the understanding of the dynamics of digital transformation in a regulated sector and opens avenues for future research and innovative managerial practices. In line with this objective, the analysis is guided by the following research questions:

RQ1: How do institutional (primarily regulatory) pressures influence the adoption and use of smart tachographs and related digital technologies in transport companies in Bosnia and Herzegovina?

RQ2: How do differences in the level of digital maturity and the use of digital technologies relate to the way companies use tachograph, telematics and navigation data in operational and strategic decision-making?

RQ3: How can the observed differences in the use of technologies and data be interpreted in relation to institutional pressures and internal digital capacities?

The paper is structured so that after the theoretical framework and methodology, it presents the results of empirical research, which are then interpreted in the context of relevant theoretical approaches and ends with a conclusion and recommendations for practice and future research.

## 2. THEORETICAL PERSPECTIVES ON DIGITALISATION AND DIGITAL TRANSFORMATION

Digitalisation refers to the use of technology to reshape business models and improve operational efficiency, while digitisation is limited to the conversion of analogue content into digital form [3–4]. Contemporary trends, along with big data analytics, artificial intelligence and the Internet of Things, have fostered the integration of business functions to create data-driven organisations [2]. Digital maturity stands for being at a point in evolution that goes from partial implementation of digital solutions for business models’ total transformation, in which digital competences become a source of competitive advantage [5].

The transport sector is among the industries undergoing the fastest digital transformation, driven by the complexity of global supply chains and regulatory requirements aimed at ensuring safety and sustainability. The concept of Logistics 4.0 encompasses the use of IoT sensors, telematics, predictive analytics and blockchain technologies to enhance efficiency and transparency [6]. These digital solutions contribute to route optimisation, cost reduction and improved safety [7]. However, this transformation is not limited to the technological domain; it also requires adaptation of organisational processes and alignment with sustainability objectives [8].

However, a gap remains between technologically advanced companies and traditional actors in the transport sector. A review of the literature indicates that many firms are still not digitally prepared, although an increasing number recognise the need for change and are willing to overcome obstacles such as high costs and the lack of standards [9].

Smart tachographs illustrate the whole gamut of transport digitalisation by satisfying regulatory requirements and instigating organisational transformation processes. They use GNSS modules, DSRC communication and security protocols that automate location recording with remote data access and enhanced security in comparison to earlier versions [10]. Their usage promotes data-driven fleet management in the optimisation of routes, reduction of costs and control of drivers' working hours [11–12]. From the perspective of digital maturity, smart tachographs are not merely compliance tools but serve as catalysts in triggering a transition to integrated data-based business models. The run for road transport consists of three main phases, starting with the analogue device and moving on to modern actuating systems. *Table 1* summarises the main aspects of each phase and their contribution to the digitalisation of the transport sector.

*Table 1 – Evolution of tachographs in road transport*

Phase	Period	Key features	Contribution and limitations
<b>Analogue tachographs</b>	until 2006	Recording of data on paper charts	Simple, but prone to manipulation and required manual administration
<b>Digital tachographs</b>	from 2006	Electronic memory, smart cards	Increased security and reduced possibility of falsification
<b>Smart tachographs (GEN1)</b>	from 2019	GNSS module, DSRC communication, security protocols	Automated location recording and remote data reading
<b>Smart tachographs (GEN2)</b>	from 2023	Automatic border recording, integration with ITS systems	Greater monitoring efficiency and compliance with EU regulations

*Source: Adapted from Baldini & Chiramello, 2018 [10]*

The concept of digital maturity rests on the idea that organisations gradually advance from basic forms of digitalisation to more integrated, data-driven models. Models of digital maturity usually include several key dimensions, such as strategy, leadership, processes, organisational culture, human resources and technology. Higher levels of maturity are typically linked with stronger business integration and a greater reliance on data-informed decision-making [13]. In this context, smart tachographs can be viewed as having a dual role: companies with higher levels of maturity tend to adopt them earlier, while in less mature organisations, they often act as a catalyst for the development of analytics and process improvements, leading to lower costs, increased reliability and faster compliance with regulatory requirements.

Institutional theory, on the other hand, emphasises that the adoption of new technologies is not shaped only by internal benefits but also by external pressures and the need for legitimacy [14]. It distinguishes between three types of pressures: coercive pressures, such as EU Regulation 165/2014 and the Mobility Package [14–15]; normative pressures, including industry standards and client expectations; and mimetic pressures, where companies imitate more successful competitors in situations of uncertainty [14]. These mechanisms help explain why the digital transformation of vehicle fleets is driven not only by internal business motives but also by regulatory, industrial and market forces. In Bosnia and Herzegovina, where regulations are progressively being harmonised with the EU acquis, institutional factors serve as a particularly strong driver of the adoption of digital tachographs.

The resource-based view (RBV) adds a complementary perspective, assuming that competitive advantage stems from resources and capabilities that are valuable, rare, difficult to imitate and non-substitutable. In today's digital environment, knowledge and digital competencies stand out as especially important, as they enable organisations to build new capabilities and enhance existing processes. Within this framework, digital resources, such as data and advanced analytics, form the basis for long-term value creation, particularly when they are applied to process optimisation and real-time decision-making [16].

Research confirms that digital capabilities are crucial for sustaining competitive advantage, as they enable faster adaptation to market changes and regulatory requirements [17]. The integration of digital resources into strategic management underscores the need to develop internal capacities, where data, such as those collected through smart tachographs, are not perceived solely as a regulatory obligation, but also as a strategic resource that drives innovation and the transformation of business models [18].

Previous studies in Bosnia and Herzegovina have shown that the digitalisation of the transport sector has been largely driven by regulatory alignment with European legislation. Šego [19] points out that the introduction of digital tachographs was an important step forward, but also a challenge for carriers due to higher costs and the need to adjust business processes. Karić [20] draws further attention to the technical obstacles in the gradual harmonisation with EU regulations. These works are valuable as they document the early stages of digitalisation in Bosnia and Herzegovina, yet their contribution remains mostly descriptive and confined to regulatory and technical aspects, without a deeper analysis of strategic effects or the connection to the digital maturity of companies. At the regional level, Borić et al. [21] highlight the safety function of tachographs through the reduction of driver fatigue and the monitoring of working hours.

From a technical and regulatory perspective, numerous reports and professional studies broaden existing knowledge. Baldini and Chiamello [22] analyse the smart tachograph as a regulated ITS application, focusing on DSRC and GNSS technologies, while Suchanek [23] discusses the costs of retrofitting in the EU. The European Commission [24] emphasises the need to balance regulatory requirements with benefits for the labour market and road safety. These sources clearly articulate the European context, yet it remains uncertain to what extent their findings can be applied to transitional countries such as Bosnia and Herzegovina, where institutional dynamics are less developed. Academic studies, including those of Baldini et al. [10], Borio et al. [25] and Baldini et al. [26], provide detailed accounts of the technical specifications and security mechanisms of the second generation of smart tachographs. However, their perspective remains largely confined to engineering and regulatory aspects, with limited attention to broader organisational and strategic implications. Recent studies increasingly link institutional pressures with digital maturity in transport and logistics. Kuo et al. [27] show that digital transformation is shaped by coercive and mimetic pressures, indicating that regulation and competition influence both technology adoption and achieved benefits. From the digital maturity perspective, Golińska-Dawson [28] finds that external regulatory and market drivers affect the depth and effectiveness of logistics digitalisation, while Suhail et al. [29] similarly associate stronger institutional pressures with higher transformation maturity and improved performance. Extending institutional theory to logistics performance, Coşkun et al. [30] show that institutionalisation mechanisms shape internal capabilities that enable organisations to translate compliance requirements into operational improvements. Building on these insights, this study examines how institutional pressures and internal digital capacities influence digital maturity and the strategic use of smart tachograph data in transport companies in Bosnia and Herzegovina.

Internal digital capacities refer to organisational capabilities related to the collection, integration, management and analysis of digital data, as well as the ability to translate these insights into operational and strategic decision-making. In the context of this study, these capacities are primarily observed in relation to data generated by smart tachographs and related telematics systems.

That is one of the examples in recent literature proposing the transformation of smart tachographs. Kaushik [12] claims a modular approach to digitalisation, envisaging route optimisation and predictive maintenance techniques to offer a quick return on investment. On the other hand, through the example of Lithuania in applying the Mobility Package [31], it is evident how a regulatory uplift can stagger the costs significantly and the period of adjustment, raising the question of whether smaller markets and carriers are ready to take up such complex regulatory requirements.

Overall, existing research provides a valuable overview of the technical, regulatory and safety aspects of tachographs, yet it remains largely confined to the engineering or industry level. A gap persists in understanding how external institutional pressures interact with firms' internal capacities, and how these processes are reflected through digital maturity and the development of competitive advantage. This study addresses that gap by integrating institutional theory, the resource-based view (RBV) and concepts of digital maturity into a single framework that explains how smart tachographs function not only as instruments of regulatory compliance but also as catalysts of transformation and creators of strategic value in the transport sector of Bosnia and Herzegovina.

Conceptual framework (“stack”): Building on existing approaches such as digital capability stacks and digital layers developed in other sectors (e.g. finance and healthcare) and on the literature on platform ecosystems and technology/data architectures [32–35], this paper proposes the original conceptual framework – the digital stack – which systematises the levels of digital transformation of the transport sector. Based on institutional theory, the resource-based view (RBV), which emphasises the strategic importance of rare, valuable and hard-to-imitate resources, and digital maturity models, the framework illustrates how organisations progress from regulation-driven initial stages towards creating strategic value from data and analytics.

At the foundation of the stack are compliance devices and sensors – primarily smart tachographs, telematics and navigation systems – whose primary role is to ensure regulatory compliance. On this basis, integration with fleet management systems, ERP/DMS systems and other internal applications is developed, which enables broader data connectivity within the organisation. The next level concerns data management, including data quality, availability and ownership. According to RBV logic [36], it is precisely the competencies for data management and integration that are a specific organisational resource that creates long-term value. Analytics is built on this foundation, evolving from descriptive to predictive and prescriptive, and its results are integrated into day-to-day managerial and operational decision-making.

Analytical capabilities thus become a rare and hard-to-imitate resource that enables differentiation and sustainable competitive advantage within the sector. At the top of the digital stack are the outcomes – greater efficiency, improved safety and cost reduction. Within this framework, regulation serves as an initial trigger, while the level of digital maturity determines how far a company can progress through individual layers. This integrates external institutional pressures and internal organisational capacities into a single perspective, with the RBV particularly emphasising that the ability to create value stems from the development and utilisation of specific resources, which explains the dynamics of digital transformation in the transport sector.

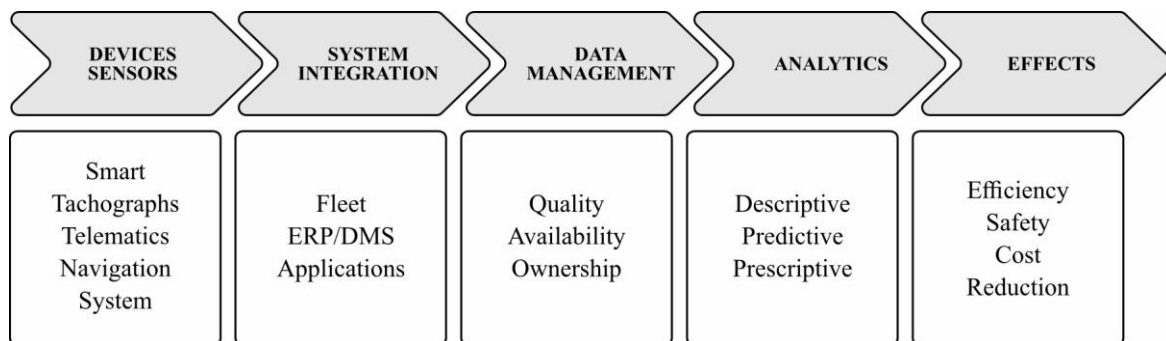


Figure 1 – Conceptual framework (“digital stack”) for the digital transformation of the transport sector

Building on these theoretical foundations, the paper positions digitalisation as the main explanatory construct and explores its relationships with:

- the integration of navigation systems and smart tachographs, as well as the application of telematics;
- the frequency of data-driven decision-making;
- the perceived usefulness of data.

### 3. RESEARCH METHODOLOGY

The research was conducted in 2025 as a quantitative empirical study aimed at exploring the relationship between regulatory pressures (institutional theory), the level of digital maturity in enterprises, and perceptions regarding the opportunities and challenges arising from a change to smart tachographs. The target population consisted of companies in the transport sector in Bosnia and Herzegovina that utilise or are required to utilise tachographs. Since the main objective of the study is to provide a theoretical contribution through the integration of institutional theory, the resource-based view (RBV) and the concept of digital maturity, the empirical analysis is primarily exploratory in nature. The findings, therefore, illustrate and test the assumptions of the research framework but are not fully generalisable to the population of transport companies.

The study is based on a convenience sample of 85 transport companies. Companies were selected based on accessibility through professional networks and industry contacts, and respondents were owners or managers responsible for operational or strategic decision-making. While this sampling approach limits the generalisability of results, it is appropriate for exploratory research in under-researched contexts such as the digital transformation of transport companies in Bosnia and Herzegovina. The sample structure is presented in Table 2.

Table 2 – Structural characteristics of the surveyed companies

Variable	Category	%
Company size	Up to 49 employees	62,4
	50–249 employees	11,8
	250+ employees	25,9
Core business activity	Transport as a primary activity	69,4
	Transport as a secondary activity	30,6
Number of vehicles with tachographs	Fewer than 10	36,5
	10–50	44,7
	More than 50	18,8
Purpose of transport	Service for third parties	52,9
	Internal transport	36,5
	Passenger transport	10,6

Source: Authors' own survey and SPSS analysis (2025)

The findings show that the sample is largely composed of small enterprises with fewer than 50 employees and relatively small fleets, while medium and large companies are less numerous but still form an important segment. For most respondents (69.4%), transport is the primary activity, with freight transport being the most dominant, whereas passenger and internal transport are less common. This distribution closely reflects the structure of the transport sector in Bosnia and Herzegovina, where the market is mainly driven by small carriers, while larger companies, though fewer in number, operate with greater resources and larger fleets.

The study involved representatives of the management structures of transport enterprises in Bosnia and Herzegovina, most often managers and owners responsible for operational and strategic decisions. The survey targeted individuals with relevant knowledge of business processes and digital technologies within their fleets, ensuring that the data collected captured the perspectives and experiences of key decision-makers.

The questionnaire was structured into several sections: general company information, level of digitalisation, perception of regulatory pressures, perceived benefits and challenges of adopting smart tachographs, and the use of additional technologies such as telematics and navigation systems. Most items were designed as Likert-scale questions ranging from 1 (“strongly disagree”) to 5 (“strongly agree”). The reliability of multi-item scales was tested using Cronbach’s alpha coefficient (e.g. the challenges scale  $\alpha = 0.701$ ). These indicators are aligned with the core dimensions commonly found in established digital maturity models, but they function as perception-based proxy measures, which is taken into account when interpreting the findings.

Data were processed using IBM SPSS Statistics software, employing the following methods:

- Descriptive statistics (frequencies, percentages, means, standard deviations),
- Correlation analysis (Spearman’s rho) to examine the relationship between digitalisation and perceived benefits,
- Chi-square tests ( $\chi^2$ ) to analyse relationships between categorical variables,
- t-tests to compare perceptions of benefits across different groups (drivers, companies, supervisory bodies),
- Factor analysis (PCA with Varimax rotation) to identify the dimensions of barriers to transition,
- Reliability testing (Cronbach’s alpha) to assess the internal consistency of scales [37–39].

The main objective of the study was to examine the level of digitalisation of transport enterprises in Bosnia and Herzegovina, with a focus on the implementation of smart tachographs, and to identify the benefits and challenges of their application. Particular emphasis was placed on the role of institutional pressures (regulations, competition, client expectations) in the process of adopting new technologies.

The sample reveals the dominance of small carriers, with the presence of medium-sized and a few large companies. Transport is predominantly the primary activity, with a strong focus on freight operations. Such a structure reflects the actual challenges and opportunities of digitalisation, where the readiness to introduce smart tachographs varies according to company size, fleet size and business model.

### 3.1 Research results

#### *State of digitalisation in the transport sector*

The findings indicate that the transport sector in Bosnia and Herzegovina is undergoing an intensive phase of digital transformation. Analogue tachographs have nearly disappeared from practice (3.5%), while most companies rely on a combination of digital and smart devices (31.8%) or exclusively on digital tachographs (28.2%). An additional 22.4% reported the simultaneous use of all types of tachographs, reflecting a gradual process of adaptation. Only 14.1% of companies have fully transitioned to smart tachographs, confirming that the shift is incremental and often occurs in parallel with earlier systems.

An assessment of fleet digitalisation levels further reinforces these findings: almost half of the companies (47.7%) rate their digitalisation as partial, 30.2% report a high level, while only 11.6% describe themselves as fully digitalised. A smaller share (9.3%) indicates low or no digitalisation at all. These results suggest that while most companies are investing in digital technologies, full integration has yet to be achieved.

*Table 3 – Type of tachograph and level of fleet digitalisation (N = 85)*

Category	Subcategory	%
<b>Type of tachograph</b>	Analogue	3,5
	Digital	28,2
	Smart	14,1
	A combination of digital and smart	31,8
	A combination of analogue, digital and smart	22,4
<b>Level of digitalisation</b>	None / Low	9,3
	Partial	47,7
	High	30,2
	Full	11,6

*Source: Authors' own survey and SPSS analysis (2025)*

The results presented in *Table 3* confirm that the transport sector in Bosnia and Herzegovina is currently in a transitional phase of digitalisation. Analogue tachographs have almost disappeared from practice, while the combined use of digital and smart devices remains predominant. A complete shift to smart tachographs is still limited, reflecting a gradual and parallel adjustment of the system. The assessment of fleet digitalisation levels further supports these findings – most companies rate their digitalisation as partial or high, whereas full integration remains rare. These results clearly indicate notable progress, yet also highlight that the process of digital transformation has not been fully completed.

#### *Use of telematics and navigation systems*

The results indicate that the integration of telematics and navigation technologies, in combination with tachographs, is becoming a standard in the sector. Nearly 40% of companies already use them fully, while an additional 17.6% apply them to a large extent. Partial use is observed in one-quarter of the sample, whereas only a smaller proportion either do not use them (12.9%) or are only planning implementation (7.1%).

*Table 4 – Use of telematics and navigation systems (N = 85)*

Category	%
Fully implemented	37,6
To a large extent	17,6
Partially	24,7
Not in use	12,9
Planned implementation	7,1

*Source: Authors' own survey and SPSS analysis (2025)*

*Motives for the transition to smart tachographs*

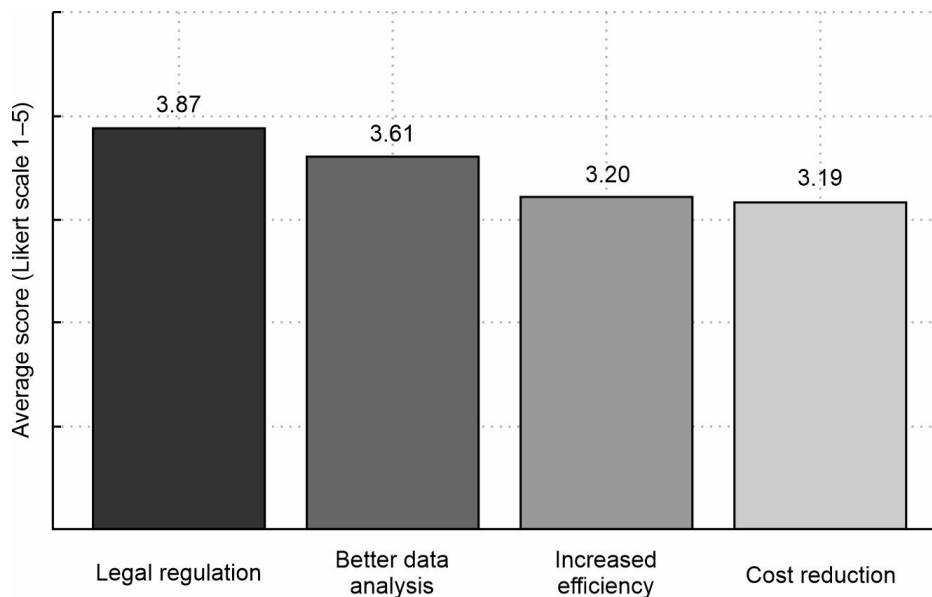
The analysis of motives for adopting smart tachographs revealed that legal regulation is the strongest driver of implementation (M = 3.87; SD = 1.25), with a considerable share of respondents fully agreeing that the regulatory framework is the key reason for transitioning to this technology. The second most important factor is the improved analysis of driver and vehicle data (M = 3.61; SD = 1.35), indicating a growing recognition of the analytical value of data in the digital environment. Motives related to increasing business efficiency (M = 3.20; SD = 1.25) and reducing administrative costs (M = 3.19; SD = 1.33) were assessed as moderately important, with greater variability in responses.

*Table 5 – Descriptive statistics of motives for the transition to smart tachographs*

Motive	N	Mean	Std. deviation	Min.	Max.	Mode
Legal regulation	85	3,87	1,25	1	5	5
Increased business efficiency	85	3,20	1,25	1	5	3
Reduction of administrative costs	85	3,19	1,33	1	5	3
Better analysis of driver and vehicle data	85	3,61	1,35	1	5	5

*Source: Authors' own survey and SPSS analysis (2025)*

The results presented in *Table 5* confirm that legal regulation is the dominant motive for the transition, which is consistent with institutional theory, while at the same time, an increasing emphasis is placed on recognising the business benefits of digitalisation. These findings suggest that the shift to smart tachographs does not stem solely from regulatory obligations but also from the potential for the strategic use of data, which can be interpreted within the framework of digital maturity and, to some extent, through the perspective of the resource-based view (RBV).



*Figure 2 – Motives for the transition to smart tachographs*

*Perceived usefulness of data*

The results show that companies, on average, evaluate the usefulness of navigation system and tachograph data in business decision-making as high (M = 3.65; SD = 0.87). The median was 4, while the mode was 3, indicating a slight asymmetry in the distribution of responses. More than half of the respondents (54.1%) rated the data as very or extremely useful, an additional 40% considered them partially useful, whereas only 5.9% perceived them as not useful.

Table 6 – Perceived usefulness of navigation system and tachograph data in business decision-making (N = 85)

Evaluation of data usefulness	% of respondents
Not useful	5,9%
Partially useful	40,0%
Very useful	54,1%

Source: Authors' own survey and SPSS analysis (2025)

The results of the Kruskal-Wallis test revealed significant differences among companies with respect to the frequency of navigation system/tachograph use ( $\chi^2(4) = 10.697$ ;  $p = 0.030$ ). Companies that employ these data more frequently in decision-making simultaneously express a more positive perception of their usefulness. The Spearman correlation analysis further confirms this relationship ( $\rho = 0.319$ ;  $p = 0.003$ ), indicating that more frequent application of the data in practice strengthens the conviction of their value.

Overall, the findings indicate that navigation system and tachograph data are perceived not merely as a regulatory obligation but also as a valuable resource for enhancing efficiency and the quality of decision-making. This conclusion supports the theoretical framework of the resource-based view (RBV), as it highlights data and digital competences as strategic resources, as well as the concept of digital maturity, which emphasises that the practical application of digital tools is what generates real business value.

#### Relationship between attitudes and perceived benefits

The analysis of the relationship between attitudes toward the introduction of smart tachographs and the perceived usefulness of data did not reveal a statistically significant association ( $\rho = 0.17$ ;  $p > 0.05$ ). This means that the fact that companies accept the implementation of smart tachographs does not necessarily imply that they perceive the collected data as a valuable resource for business decision-making. This finding points to the existence of two distinct dimensions: regulatory compliance, which stems from the obligation to adhere to the legal framework, and the recognition of the practical value of data, which requires a higher level of digital maturity and the development of organisational competencies.

After analysing companies' views on the usefulness of navigation systems and tachograph data in business decision-making, an additional examination was conducted to explore how these views relate to the reasons for adopting smart tachographs. This analysis provides a deeper understanding of the extent to which regulatory, organisational and analytical motives influence the perception and acceptance of new technologies.

#### Relationship between attitudes and motives

The Spearman correlation analysis between attitudes toward the introduction of smart tachographs and the motives for adoption revealed a significant positive association. The strongest correlations were observed between attitudes toward implementation and the perception of reduced administrative costs ( $\rho = 0.594$ ;  $p < 0.01$ ) as well as improved analysis of driver and vehicle data ( $\rho = 0.587$ ;  $p < 0.01$ ). The relationship with increased business efficiency was also significant ( $\rho = 0.478$ ;  $p < 0.01$ ), while the correlation with legal regulation was weaker but still statistically significant ( $\rho = 0.217$ ;  $p < 0.05$ ).

Table 7 – Relationship between attitudes toward the introduction of smart tachographs and motives for adoption

Adoption motive	$\rho$ (Spearman)	p-value	Significant
Reduction of administrative costs	0,594	< 0,01	significant
Better data analysis	0,587	< 0,01	significant
Increased business efficiency	0,478	< 0,01	significant
Legal regulation	0,217	< 0,05	significant

Source: Authors' own survey and SPSS analysis (2025)

The results show that companies with a more positive evaluation of the introduction of smart tachographs also assess the motives for adoption as more important. This finding confirms the consistency of attitudes and highlights the link between regulatory and business dimensions, thereby connecting institutional logic (regulation as an obligation) with business benefits within the framework of digital transformation.

### Benefits for different stakeholders

The analysis of perceptions regarding the benefits of fleet digitalisation revealed clear differences among groups. The results of the paired samples t-test showed that the benefits for supervisory authorities were rated significantly higher than those for companies ( $M_{diff} = -1.082$ ;  $p < 0.001$ ) and drivers ( $M_{diff} = -1.247$ ;  $p < 0.001$ ). The difference between drivers and companies, however, was not statistically significant.

Table 8 – Comparison of the assessed benefits of fleet digitalisation by stakeholder groups

Group comparison	Mean difference (Mdiff)	p- value	Significance
Supervisory authorities - companies	-1,082	< 0,001	significant
Supervisory authorities - drivers	-1,247	< 0,001	significant
Companies - drivers	-0,165	0,214	not significant

Source: Authors' own survey and SPSS analysis (2025)

The finding strongly supports institutional theory, as it confirms that digitalisation is primarily perceived from the perspective of regulatory authorities and oversight. At the same time, the internal benefits for companies and drivers remain secondary, indicating the predominance of coercive institutional pressures over strategic or organisational benefits.

### Impact on driver offences

The perception of the impact of smart and digital tachographs on driver offences produced strong results. Almost 40% of respondents believe that tachographs have significantly reduced offences, while an additional 36.5% assessed that there is a partial effect. Only 18.8% of respondents consider that tachographs have no impact, and an increase in offences was reported by just 1.2% of respondents.

Table 9 – Perception of the impact of tachographs on driver offences (N = 85)

Assessment of tachograph impact	% of respondents
Significant reduction	40,0%
Partial reduction	36,5%
No impact	18,8%
Increase in offenses	1,2%

Source: Authors' own survey and SPSS analysis (2025)

The results of the chi-square analysis confirmed a significant association between the type of tachograph and the perceived impact on driver offences ( $\chi^2 = 26.984$ ;  $p = 0.042$ ). In contrast, the correlation with the level of digitalisation was not significant ( $p = 0.042$ ;  $p = 0.703$ ), suggesting that the effect is perceived universally, regardless of a company's degree of digital maturity. This finding provides strong support for institutional theory, as it confirms that regulatory pressures through the mandatory implementation of smart tachographs exert a real influence on driver behaviour, independent of internal capacities or digital resources of companies.

### Readiness to invest in artificial intelligence

The analysis of companies' readiness to invest in artificial intelligence (AI) revealed clear differences across groups of different sizes. The results showed that smaller companies (1–49 employees) expressed a lower level of investment readiness (43%), whereas the share was considerably higher among medium-sized and large companies (around 70%).

Table 10 – Readiness to invest in AI by company size

Company size	Ready to invest (%)	Not ready to invest (%)
Small (1–49 employees)	43,0%	57,0%
Medium (50–249 employees)	70,0%	30,0%
Large (250+ employees)	71,0%	29,0%

Source: Authors' own survey and SPSS analysis (2025)

The Pearson  $\chi^2$  test did not reveal a statistically significant difference among all groups ( $\chi^2(2) = 5.16$ ;  $p = 0.076$ ). However, the test for linear trend indicated a significant association ( $\chi^2 = 4.41$ ;  $p = 0.036$ ), suggesting that readiness to invest in AI increases with company size. Further analysis showed a significant difference in the perceived importance of AI between companies that are ready and those that are not ready to invest. The results of the Mann-Whitney U test confirmed that companies planning to invest rated the strategic importance of AI significantly higher (Mean Rank = 52.7) compared to the others (Mean Rank = 32.1;  $U = 462.0$ ;  $Z = -4.003$ ;  $p < 0.001$ ).

The results of the logistic regression further confirm these findings: the model significantly predicts readiness to invest ( $\chi^2(4) = 26.75$ ;  $p < 0.001$ ), explaining 27–36% of the variance. The strongest predictor was the perceived importance of AI ( $B = -0.998$ ;  $p < 0.001$ ;  $\text{Exp}(B) = 0.369$ ), while company size ( $p = 0.067$ ) and type of tachograph ( $p = 0.075$ ) showed a trend toward significance. The level of digitalisation did not demonstrate an independent predictive effect ( $p = 0.728$ ).

Overall, the findings confirm that perceptions and available resources are stronger drivers of investment in AI than the formal level of digital maturity. This conclusion is consistent with the resource-based view (RBV), which posits that competitive advantage is built on intangible resources and capabilities, in this case, knowledge, digital competencies, and the strategic orientation of management toward innovation.

### *Challenges of transition*

The analysis of challenges in transitioning to smart tachographs revealed two main dimensions of barriers:

- Organisational-perceptual barriers – implementation costs, driver resistance and insufficient awareness.
- Technical-regulatory barriers – challenges of integration into existing systems and the legal obligation.

The reliability of the scale was satisfactory (Cronbach's  $\alpha = 0.701$ ), confirming the internal consistency of the measurement instrument. However, the analysis of the relationship with the level of digitalisation did not produce statistically significant results, indicating that barriers are perceived universally, regardless of a company's digital maturity. This finding can be interpreted through institutional theory, which suggests that resistance to new regulations and obligations stems from external pressures rather than from internal readiness or organisational capacity.

## **3.2 Discussion**

The findings can be interpreted through the combined lens of institutional theory, the resource-based view and digital maturity in line with the core research questions guiding this study. Regulatory pressures primarily explain the adoption of digital technologies, while differences in digital maturity account for variation in how firms exploit these technologies. From an RBV perspective, internal digital capacities emerge as strategic resources that enable some firms to move beyond compliance toward value creation.

### *Theoretical implications*

The findings confirm the dual dynamics of the digitalisation of the transport sector in Bosnia and Herzegovina. Regulatory pressures remain the main driver for the implementation of smart tachographs, which supports institutional theory. The finding that regulatory requirements are the most important reason for adoption ( $M = 3.87$ ; 41% strongly agree) shows that harmonisation with EU regulations shapes the behaviour of all companies, regardless of their level of digital maturity. The universal effects on the reduction of violations further confirm that regulations act as a uniform mechanism for all actors.

On the other hand, the findings indicate that digital data is gradually being recognised as a strategic resource, which is in line with the resource-based view (RBV). Positive correlations between the frequency of data use and the perception of its usefulness ( $\rho = 0.319$ ;  $p = 0.003$ ) indicate that companies are developing capabilities that are difficult for competitors to imitate. Also, the association of the level of digitalisation with the perception of efficiency ( $\rho = 0.231$ ;  $p = 0.033$ ) and the use of telematics ( $\rho = 0.295$ ;  $p = 0.006$ ) confirms the importance of the concept of digital maturity as a differentiator between mere regulatory compliance and strategic business transformation.

### *Practical implications*

The findings indicate that digitalisation brings the greatest benefits to regulatory authorities, while the benefits for companies and drivers remain less pronounced. This result suggests that transport companies need to develop internal capabilities to use technology for process optimisation and data-driven decision-making,

not just for regulatory compliance. Significantly, medium-sized and large companies are more willing to invest in AI, while small ones show hesitance. This points to the need for additional support for smaller transport operators – through education, subsidies or shared digital platforms – to ensure that digitalisation has a wider impact on the sector. Smart tachographs thus act as a bridge between regulation and strategy, ensuring oversight and compliance, while at the same time enabling the development of data-driven management and increasing competitive advantage.

These findings are not unique to the transport sector in Bosnia and Herzegovina but align with patterns observed in other industries. For example, research conducted in the transport sector showed that regulatory pressures are the prime driver of digitalisation, while the digital maturity of the organisation acts as a key motivator for further development [32–33]. A similar pattern has been observed in healthcare and education, where regulatory requirements or national policies drive the initial adoption of digital solutions, and digital maturity determines the speed and quality of transformation [40–41].

In the financial sector, digitalisation is driven by both regulatory requirements and market pressures, while digital maturity enables organisations to respond to competition and fintech challenges [38]. In manufacturing, on the other hand, competitive and market requirements are the main drivers, while regulatory pressures play a smaller role, and digital maturity delivers long-term benefits through the implementation of Industry 4.0 solutions [42]. This comparison shows that in regulated sectors (transport, healthcare, education) institutional frameworks are the dominant drivers of digitalisation, while in sectors with greater market dynamics (finance, manufacturing) competition plays a crucial role, with digital maturity universally recognised as a motivator of transformation.

#### *Limitations and future research*

This study has several important limitations. First, it was conducted with a relatively small and convenience sample ( $N = 85$ ), which reduces the generalisability of the findings. Second, the data were collected through self-reports by managers and owners, which opens room for subjective bias. Third, the research design is cross-sectional, so it is not possible to track long-term changes or cause-and-effect relationships. Finally, the focus was on the company perspective, while the views of other stakeholders (drivers, regulators, customers) were not included.

For future research, it is recommended to use larger and more representative samples and longitudinal approaches to examine the evolution of digital transformation over time. It would be useful to include qualitative methods, such as interviews with managers and drivers, to gain deeper insight into the organisational and human aspects of digitalisation. Additionally, international comparisons with EU member states can help to understand the dynamics of digital transformation in more mature institutional environments. New technologies, such as artificial intelligence and blockchain, and their role in shaping the digital maturity and competitive advantage of transport companies, deserve special attention in the future.

## **4. CONCLUSION**

This study examined the processes of digitalisation in the transport sector of Bosnia and Herzegovina, with particular emphasis on institutional pressures and the organisational readiness of firms. The findings confirm that regulatory requirements remain the primary driver of technology adoption, thereby supporting the assumptions of institutional theory. At the same time, digital maturity acts as a differentiating factor: less developed companies perceive new technologies mainly as a compliance obligation, whereas more advanced firms employ them to optimise processes, increase efficiency and support strategic decision-making.

The results suggest that digital transformation in the sector is not a linear process, but rather the outcome of an interplay between external regulatory demands and internal capabilities. Perceptions of the usefulness of navigation systems and tachograph data indicate that digital information is gradually becoming a strategic resource, in line with the resource-based view (RBV).

The theoretical contribution of this research lies in integrating institutional pressures, digital maturity and the RBV framework into a single model for analysing digitalisation in the transport sector. The practical contribution concerns highlighting the need for managers to approach smart tachographs and related tools not only as compliance instruments, but as integral components of a broader “digital stack” (devices → integration → data management → analytics → decision-making). In this way, investments in integration and analytics can transform regulatory obligations into a source of long-term competitive advantage, while for policymakers, the results demonstrate that regulation must be accompanied by measures aimed at developing digital

competencies and resources within companies. Overall, the findings provide empirical answers to the research questions by showing that regulatory pressures primarily drive the adoption of smart tachographs, while differences in internal capacities and digital maturity determine the extent to which companies are able to turn technology and data into strategic value.

The main limitation of this study is related to the size and type of the sample. Future research should rely on larger and more representative samples, include comparisons with EU member states, and apply longitudinal and qualitative approaches to gain deeper insights into managerial and driver perspectives on digitalisation and transformation processes.

In conclusion, the digitalisation of the transport sector in Bosnia and Herzegovina is shaped by a dual dynamic: institutional pressures stimulate change, whereas digital maturity determines its depth and quality. This raises possible lines of future research to track the shift from simple regulatory compliance towards intentional exploitation of digital technologies and artificial intelligence as strategic resources.

## REFERENCES

- [1] Jerković D, Gavrić T, Ljubas Ćurak J. Digital transformation in Bosnia and Herzegovina companies: Analysis of the degree of integration and impact on business. *Economy and Market Communication Review*. 2024;14(1):116-139. Available from: [https://emc-review.com/Pages%20from%20EMC%20-%20godina%20XIV\\_broj%201%20WEB-8.pdf](https://emc-review.com/Pages%20from%20EMC%20-%20godina%20XIV_broj%201%20WEB-8.pdf)
- [2] Verhoef PC, et al. Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*. 2021 Jan;122:889-901. DOI: [10.1016/j.jbusres.2019.09.022](https://doi.org/10.1016/j.jbusres.2019.09.022).
- [3] Kryukov V, Sidorov E, Tashenov S, Tokareva N. Readiness of transport enterprises for digital transformation. *Transportation Research Procedia*. 2022;63:2937-45. DOI: [10.1016/j.trpro.2022.06.333](https://doi.org/10.1016/j.trpro.2022.06.333).
- [4] Matt C, Hess T, Benlian A. Digital transformation strategies. *Business & Information Systems Engineering*. 2015;57(5):339-343. DOI: [10.1007/s12599-015-0401-5](https://doi.org/10.1007/s12599-015-0401-5).
- [5] Apanavičienė R, Shahrabani MMN. Key factors affecting smart building integration into smart city: Technological aspects. *Smart Cities*. 2023;6(4):1724-1744. DOI: [10.3390/smartcities6040086](https://doi.org/10.3390/smartcities6040086).
- [6] Winkelhaus S, Grosse EH. Logistics 4.0: A systematic review towards a new logistics system. *International Journal of Production Research*. 2020;58(1):18-43. DOI: [10.1080/00207543.2019.1612964](https://doi.org/10.1080/00207543.2019.1612964).
- [7] Ivanov D, Dolgui A, Sokolov B. The impact of digital technology and Industry 4.0 on the ripple effect and supply chain risk analytics. *International Journal of Production Research*. 2019;57(3):829-846. DOI: [10.1080/00207543.2018.1488086](https://doi.org/10.1080/00207543.2018.1488086).
- [8] Barreto L, Amaral A, Pereira T. Industry 4.0 implications in logistics: An overview. *Procedia Manufacturing*. 2017;13:1245-1252. DOI: [10.1016/j.promfg.2017.09.043](https://doi.org/10.1016/j.promfg.2017.09.043).
- [9] Kern J. The digital transformation of logistics: A review about technologies and their implementation status. In: *The digital transformation of logistics*. 2021. DOI: [10.1002/9781119646495.ch25](https://doi.org/10.1002/9781119646495.ch25).
- [10] Baldini G, Chiamarello M. Regulated applications for the road transportation infrastructure: The case of the smart tachograph in the EU. *International Journal of Critical Infrastructure Protection*. 2018;21:3-21. DOI: [10.1016/j.ijcip.2017.12.004](https://doi.org/10.1016/j.ijcip.2017.12.004).
- [11] D'Emidio M, et al. Route planning algorithms for fleets of connected vehicles: State of the art, implementation, and deployment. *Applied Sciences*. 2024;14(7):2884. DOI: [10.3390/app14072884](https://doi.org/10.3390/app14072884).
- [12] Kaushik S. Transforming fleet operations with artificial intelligence: A strategic and practical perspective. *Journal of Engineering and Applied Sciences Technology*. 2025;7(4):1-7.
- [13] Koval V, Polcyn J, Senkus P, Vovk O. Digital maturity of logistics processes assessed in the areas of technological support for performance measurement, employees, and process management. *Applied Sciences*. 2024;14(17):7893. DOI: [10.3390/app14177893](https://doi.org/10.3390/app14177893).
- [14] DiMaggio P, Powell W. Coercive, normative and mimetic pressures as drivers of environmental management accounting adoption. *Sustainability*. 2020;12(11):4506. DOI: [10.3390/su12114506](https://doi.org/10.3390/su12114506).
- [15] European Commission. Tachograph. Brussels: European Commission; [Accessed 2025 Feb 23]. Available from: [https://transport.ec.europa.eu/transport-modes/road/tachograph\\_en](https://transport.ec.europa.eu/transport-modes/road/tachograph_en)
- [16] Elia S, Margherita A, Passiante G. Resources and digital export: An RBV perspective on the drivers of digitalization. *Journal of Business Research*. 2021;129:135-146. DOI: [10.1016/j.jbusres.2021.02.045](https://doi.org/10.1016/j.jbusres.2021.02.045).
- [17] Van Hoang D. Digital capabilities and sustainable competitive advantages. *SAGE Open*. 2025;15(1). DOI: [10.1177/21582440251329967](https://doi.org/10.1177/21582440251329967).
- [18] Aglehori R, Gabler CB. Pursuing competitive advantages in the interactive digital era. *Int Journal Bus Strat Innov*. 2024;6(2):45-62.

- [19] Šego A. Digitalni tahograf i njegova primjena u Bosni i Hercegovini. *Zbornik radova Internacionalnog univerziteta Travnik*. 2017;6(15):658-663. Available from: <https://www.ceeol.com/search/article-detail?id=1347641>
- [20] Karić F. Digitalni tahografi u Bosni i Hercegovini sa osvrtom na EU. U: XI međunarodno savjetovanje *Saobraćajni i ekološki problemi država u tranziciji s aspekta integracije u Evropsku uniju*. Travnik: Internacionalni univerzitet Travnik; 2015. p. 360-7.
- [21] Borić J, Štrk H, Vilke S. Tachograph – Monitoring device for greater road traffic safety. *Pomorski zbornik*. 2024;64(1):177-188. Available from: <https://hrcak.srce.hr/318972>.
- [22] Baldini G, Chiaramello M. *DSRC CAN interface specification for the Smart Tachograph application (Version 1.5)*. EUR 31048 EN. Luxembourg: Publications Office of the European Union; 2022. DOI: [10.2760/170632](https://doi.org/10.2760/170632).
- [23] Suchanek M. The costs of retrofitting smart tachographs in HDVs in the European Union. *Transport Economic and Logistics*. 2018;77:125-130. DOI: [10.26881/etil.2018.77.12](https://doi.org/10.26881/etil.2018.77.12).
- [24] European Parliament. Retrofitting smart tachographs by 2020: costs and benefits. Brussels: European Parliamentary Research Service; 2018. Available from: [https://www.europarl.europa.eu/thinktank/en/document/EPRS\\_STU\(2018\)615643](https://www.europarl.europa.eu/thinktank/en/document/EPRS_STU(2018)615643)
- [25] Borio D, Cano E, Baldini G. Speed consistency in the smart tachograph. *Sensors*. 2018;18(5):1583. DOI: [10.3390/s18051583](https://doi.org/10.3390/s18051583).
- [26] Baldini G, Giuliani R, Gemo M, Naessens V. On the application of sensor authentication with intrinsic physical features to vehicle security. *Transport Economic and Logistics*. 2021;91:107053. DOI: [10.1016/j.compeleceng.2021.107053](https://doi.org/10.1016/j.compeleceng.2021.107053).
- [27] Kuo HM, Chen TL, Yang CS. The effects of institutional pressures on shipping digital transformation in Taiwan. *Maritime Business Review*. 2022;7(2):175-191. DOI: [10.1108/MABR-04-2021-0030](https://doi.org/10.1108/MABR-04-2021-0030).
- [28] Golińska-Dawson P, Werner-Lewandowska K, Kolińska K, Koliński A. Impact of market drivers on the digital maturity of logistics processes in a supply chain. *Sustainability*. 2023;15(4):3120. DOI: [10.3390/su15043120](https://doi.org/10.3390/su15043120).
- [29] Suhail Al Mazroui TS, et al. Maturity of digital transformation in the shipping industry: Case study among enterprises in Gulf Cooperation Council countries. *Journal of Marine Science and Technology*. 2023;20(1):115-123. DOI: [10.14710/kapal.v20i1.51246](https://doi.org/10.14710/kapal.v20i1.51246).
- [30] Coşkun AE, Erturgut R. Does institutionalization enhance logistics performance in international businesses? A moderated and mediated model. *Operations Management Research*. 2025;18:1045-1066. DOI: [10.1007/s12063-025-00542-3](https://doi.org/10.1007/s12063-025-00542-3).
- [31] Čižiūnienė K, Viduto M, Petraška A, Jarašūnienė A. The impact of the mobility package on the development of sustainability in logistics companies: The case of Lithuania. *Sustainability*. 2025;17(15):6947. DOI: [10.3390/su17156947](https://doi.org/10.3390/su17156947).
- [32] Healthcare Information and Management Systems Society (HIMSS). *HIMSS digital health indicator: A framework for measuring digital health transformation*. 2023. Available from: <https://www.himss.org>
- [33] Deloitte. *Digital banking maturity 2023: Global edition*. 2023. Available from: <https://www2.deloitte.com>
- [34] Tiwana A. *Platform ecosystems: Aligning architecture, governance, and strategy*. Amsterdam: Elsevier/Morgan Kaufmann; 2014.
- [35] Bresnahan TF, Greenstein S. Technological competition and the structure of the computer industry. *Journal of Industrial Economics*. 1999;47(1):1-40. DOI: [10.1111/1467-6451.00088](https://doi.org/10.1111/1467-6451.00088).
- [36] Nguyen TNL, et al. Factors leading to the digital transformation dead zone in shipping SMEs. *Sustainability*. 2025;17(12):5553. Available from: <https://www.mdpi.com/2071-1050/17/12/5553>
- [37] Field A. *Discovering statistics using IBM SPSS Statistics (5th ed.)*. 2018. Sage Publications.
- [38] Cohen J, Cohen P, West SG, Aiken LS. *Applied multiple regression/correlation analysis for the behavioral sciences (3rd ed.)*. 2003. Routledge.
- [39] Cronbach LJ. Coefficient alpha and the internal structure of tests. *Psychometrika*. 1951;16(3):297-334. DOI: [10.1007/BF02310555](https://doi.org/10.1007/BF02310555).
- [40] Hinings B, Gegenhuber T, Greenwood R. Digital innovation and transformation: An institutional perspective. *Information and Organization*. 2018;28(1):52-61. DOI: [10.1016/j.infoandorg.2018.02.004](https://doi.org/10.1016/j.infoandorg.2018.02.004).
- [41] OECD. *Digital education outlook 2021: Pushing the frontiers with AI, blockchain and robots*. Paris: OECD Publishing; 2021. DOI: [10.1787/589b283f-en](https://doi.org/10.1787/589b283f-en).
- [42] Schumacher A, Erol S, Sihn W. *A maturity model for assessing Industry 4.0 readiness and maturity of manufacturing enterprises*. Procedia CIRP. 2016;52:161-6. DOI: [10.1016/j.procir.2016.07.040](https://doi.org/10.1016/j.procir.2016.07.040).