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The Role of Technology in Enhancing International Logistics Performance

A Study of Digital Transformation in International Logistics and Supply Chain Performance

School of Marketing and Communication
Major
Master's Degree Programme in International Business

Vaasa 2026

UNIVERSITY OF VAASA
School of Marketing and Communication

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Title of the thesis:	The Role of Technology in Enhancing International Logistics Performance: A Study of Digital Transformation in International Logistics and Supply Chain Performance		
Degree:	Master's Programme		
Degree Programme:	Master's Degree Programme in International Business		
Supervisor:	Zaheer Khan		
Year:	2026	**Pages:**	65

Abstract

The study explores how digital technologies can be used to facilitate the performance of international logistics through the creation of organisational capabilities. The traditional logistics systems in the environment of the ever-increasing complex and globalised supply chains are confronted by issues such as inefficiency, lack of visibility, poor coordination and susceptibility to disruptions. Emerging technologies of the future, like the Internet of Things (IoT), artificial intelligence (AI), blockchain, big data analytics, and automation, have been identified as potential enabling technologies of Logistics 4.0 that will facilitate real-time tracking, predictive decision-making, and process automation. Nevertheless, the real-world use and implementation of these technologies are still skewed in the distribution of organisations and regions, which has led to the necessity of a more comprehensive understanding of the mechanisms by which digital technologies can affect logistics results.

By adhering to an inductive, qualitative style of research and utilising thematic analysis as an approach to synthesising secondary literature, this study implements a synthesis method that is both qualitative and interpretivist. The study recognises the important dimensions of digital technologies such as cost efficiency, timeliness, reliability, flexibility, and sustainability. The results indicate that performance impacts of digital technologies are mostly mediated by organisational capabilities, especially visibility, integration, decision-support, and resilience. In addition, the study also identifies important adoption barriers such as resistance to change, lack of leadership support, technological complexity, and regulatory constraints and enabling factors such as strategic alignment, workforce development, robust infrastructure and inter-organisational collaboration.

The theoretical value of the study is achieved through combining the value of the Resource-Based View, the Theory of the Economic of Scale, and the Diffusion of Innovation frameworks, which altogether explicates the interplay between technology adoption, development of capabilities, and contextual conditions to yield the impact on logistics performance. In practicality, the study can inform the logistics managers and policy makers on the importance of holistic digital transformation strategies, which ensure technology implementation is done in relation with organizational capabilities and strategic

objectives. The study also outlines prospects of future research, such as empirical validation, new technologies, and the issue of regulatory and environmental factors in determining technology usage and performance achievements in international logistics.

Keywords: International logistics, digital technologies, organisational capabilities, Logistics 4.0, supply chain performance

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Chapter 01: Introduction

1.1 Research Background

Logistics International logistics is very important as it helps in the global trade field, where it facilitates free and reliable transport of goods worldwide. Nevertheless, the growing globalisation, logistical complexity, and constant disruptions, including the COVID-19 crisis and political unrest, have revealed the weaknesses of the conventional logistics systems. These issues have escalated the pace of digital transformation, whereby advanced technology is being more incorporated in the logistics activities to make them more efficient, visible, and responsive (Samuels, 2025). Over the past few years, Internet of Things (IoT), Artificial Intelligence (AI), blockchain, big data analytics, and Transportation Management Systems (TMS) have become major sources of smart logistics enablers. Such technologies enable real-time tracking, predictive analysis, automated areas, and data-driven decision-making. These enhance the operational performance and supply chain resilience (Idrissi et al., 2024). To give an example, the IoT allows tracking of goods in real-time and enhances their traceability and transparency, whereas AI allows predicting demand, devising optimal routes, and identifying anomalies (Nalbantoğlu, 2025).

This technological change manifests itself in the concept of "Logistics 4.0", in which there can be autonomous and responsive logistics operations with interconnected systems and intelligent processes. With the use of digital integration, logistics systems can enhance coordination among various parties involved, decrease inefficiency, and react better to market changes (Nouhaila & Hamid, 2025). Moreover, empirical evidence indicates that companies that embrace the use of digital technologies within their supply chains are capable of lowering operational expenses by up to 20-30% in addition to improving their performance with regard to service (Atieh, 2025). Nevertheless, the usage of digital technologies in international logistics is still not even across different regions and organisations. The obstacles of infrastructure, skills, integration, and regulatory restrictions continue to hamper the full utilisation of the benefits of digital transformation for many firms. Up to now, with the continued development of global supply chains, the impact

of digital technologies on logistics performance can be of great interest to academic research and even practical use.

1.2 Research Problem Statement

Despite the popularity of digital technologies as a paradigm of change in the logistics industry, the range between the potential and practical application of the technologies in the service of international logistics is quite significant. According to traditional ways of logistics operation, lack of visibility, absence of coordination among the stakeholders, delay in responding to decisions, and poor responses to disruption are among many challenges that characterise its inefficiency. The problems also get magnified in global logistics because of the multi-layered cross-border policies, the use of multiple intermediaries, and the disseminated information systems (Samuels, 2025). Although the literature exists on the effects of individual technologies, like AI, IoT, or blockchain, it seems to be very disjointed. The majority of studies are concentrated on technological applications in isolation instead of considering the interaction of combinations of technologies to affect logistics performance in a holistic way (Nouhaila & Hamid, 2025). This disjointed strategy restricts the capacity of the organisations to develop an idea of how coordinated digital solutions can promote operational power and performance results. In addition, although it has been proven that digital transformation can greatly streamline logistics and help to save costs, a variety of organisations cannot overcome adoption obstacles. They are high initial costs of investing, resistance to organisational change, cybersecurity concerns, and interoperability among various technological systems (Samuels, 2025). These issues can cast doubt on the decision-makers ' judgment on the worthiness and viability of adopting digital technologies in the logistics business.

The other urgent question is the inability to find a comprehensive theoretical framework that would connect digital technologies with logistics performance. Although theories like the Resource-Based View (RBV), the Transaction Cost Economics (TCE) and the Diffusion of Innovation (DOI) can be useful in explaining the relationship, the studies that have integrated these two perspectives to address how technology adoption translates to better logistics results form little research. The systematic and integrative analysis linking digital technologies with organisational capabilities and logistics performance is,

therefore, needed. In the absence of such an understanding, organisations will be unable to find effective strategies in digital transformation and will not accomplish the target performance improvement.

1.3 Research Aim and Objectives

This study aims to examine how digital technologies influence international logistics performance through the development of organisational logistics capabilities. The research objectives include –

- To identify the main digital technologies discussed in the literature in relation to international logistics
- To analyse how these technologies contribute to specific logistics performance dimensions, including cost efficiency, timeliness, reliability, and flexibility
- To examine the organisational capabilities enabled by digital technologies that mediate performance improvements
- To synthesise reported barriers and enablers affecting digital technology adoption in international logistics.

1.4 Research Questions

The research questions are –

- What are the main digital technologies discussed in the literature?
- How do digital technologies influence international logistics performance according to existing literature?
- Which organisational capabilities mediate the relationship between digital technologies and logistics performance?
- What barriers and enabling factors shape the adoption of digital technologies in international logistics contexts?

1.5 Research Rationale

Increased acceleration of digital technologies has fundamentally transformed the world logistics environment, and it is imperative to know how it can help improve the performance of international logistics. The need to maintain the pace of global trade and commerce demands speed, efficiency and resilience, due to which the conventional systems of logistics are no longer able to meet the demands of the modern global trading conditions. The strategic way out of such problems is through digital transformation, which provides the ability to exchange data in real time, automate and make decisions based on reasoning (Idrissi et al., 2024). This study is relevant since it fills an important gap in the literature. Although the research has been conducted concerning individual technologies in the past, including AI, IoT, or blockchain, there is a dearth in the literature that would offer an integrated approach that interconnects these technologies to organisational performance in terms of capabilities and logistics outcomes. This research adds to the general understanding of how the digital transformation can be successfully applied to international logistics by synthesising current knowledge.

In the practical context, the results of this study are very important to the logistics managers, policy makers and industry stakeholders. The interpretation of the connection between digital technologies and logistics performance can assist organisations in making wise choices about the use of technology, investment strategies, and operational enhancement. Also, the identification of the primary barriers and enablers may be used to reinforce the formulation of effective strategies to address the implementation challenges and reap the benefits of the digital transformation to the fullest. Moreover, this study is relevant within the framework of disruptions on a global basis and growing uncertainty in supply chains. The digital technology increases the resilience of the supply chain through greater visibility and a basis for predictive analytics and response time to disruption (Samuels, 2025). Consequently, those organisations that manage to implement digital technologies in an efficient way are more likely to remain competitive in a dynamic global context.

The theoretical implication of this study in the field of business studies is that the study incorporates various views, such as RBV, TCE, and DOI, in explaining the containment

between technology adoption and logistics performance. This conceptual synthesis offers a better basis for future studies on the topic of digital logistics. Overall, the research is legitimate because it can eliminate this gap between theory and practice by offering an important insight into how digital technologies can be used to improve the performance of international logistics in an environment that, however, is more complex and competitive than ever in the global market.

Chapter 02: Literature Review

2.1 Chapter Introduction

This chapter critically examines the literature regarding the performance of international logistics and how digital technologies affect it. It will help to create a conceptual and theoretical base through the synthesis of existing literature and by determining the major debates and gaps. The initial issue that the chapter presents is the concept of international logistics performance, which encompasses its definition, dimensions and applicability to global trade. Then it discusses how digital technologies, including IoT, artificial intelligence, blockchain and data analytics, can change the functioning of logistics to improve its performance. The discussion also includes the analysis of the role that these technologies play in contributing towards the development of logistics capabilities, such as visibility, coordination and decision-making. It also assesses the effects of digital technologies on the performance of logistics and the obstacles and facilitators that govern their implementation. Lastly, the chapter will give the theoretical framework and research gaps, which will be used to frame the methodology and analysis to follow.

2.2 Conceptualising International Logistics Performance

2.2.1 Defining International Logistics Performance

The conceptualisation of international logistics performance usually addresses efficiency and effectiveness, measuring the capability to transport goods, information, and services across borders in global supply chains. It includes the capability of logistics systems to provide their delivery on time, control costs, and synchronisation of actions of various actors in geographically dispersed conditions (Arvis et al., 2024; Wang et al., 2024). The Logistics Performance Index (LPI), which is a globally adopted composite framework, offers an integrated approach to measuring such performance on national and organisational scales, which incorporates aspects like efficiency of customs, quality of infrastructure, and the quality of services.

Nevertheless, there is an ambiguity of thought in the literature, with logistics performance either being defined as an operational outcome (e.g., speed of delivery) or more

generally as a system capability in terms of coordination, visibility, and integration (Bugarčić et al., 2020; Stević et al., 2024). This duality underscores the main weakness: performance tends to be considered as a fixed measure as opposed to a dynamic capacity conditioned by technological and organisational matters. According to recent studies, international logistics performance must be perceived as a multidimensional construct that integrates operational efficiency with systemic responsiveness and resiliency (Bayraktar et al., 2025).

2.2.2 Core Dimensions of Logistics Performance

Even within the literature, a set of fundamental dimensions that form the base of logistics performance has always been identified, albeit in varying degrees of significance in different studies. The LPI framework shows six main indicators, namely, the efficiency of customs clearance, the quality of infrastructure, international shipments, the competence of logistics services, tracking and tracing, and timeliness. All these dimensions are used to reflect both the operational performance and the supporting system performance. Among those, timeliness and reliability are often highlighted as the essential performance metrics, as they are the signs of the growing need to have reliable and predictable delivery systems just in time (Puspitorini, 2025). The issue of cost efficiency also remains the most important, as the cost of logistics has a major effect on the profitability of firms and competitiveness in trade (Hausman et al., 2005; OECD, 2005).

However, researchers reckon that such classical dimensions cannot be used alone. Modern studies also emphasise flexibility and responsiveness as the increasingly important components of international affairs, especially in fluid interconnected global markets where disruption occurs in the form of international pandemics and political instability (Bayraktar et al., 2025). This implies that performance measurement based on efficiency should be replaced with a resilience-based performance measurement. More importantly, the assumption that these dimensions are weighted equally according to the composite indices like the LPI has been criticised, so that empirical research shows that some of these factors have a disproportionate impact on overall performance scores (Sharawi et al., 2025). This casts doubts on the applicability of standardised measurement methodology and justifies the need to have context-bound assessment systems.

2.2.3 Logistics Performance in International Trade and Competitiveness

Trade facilitation and national competitiveness have close relations with international logistics performance. Empirical data continually assert that trade levels and transaction costs decrease with the enhancement of the efficiency of logistics (Wang et al., 2024; Thu & Thu, 2025). Effective logistics infrastructure contributes to the expansion of export capabilities because it allows more comfortable and efficient transportation of products across borders and improves the integration of a country into the international market (Bugarčić et al., 2020). Moreover, the logistics performance has been noted to be one of the most important determinants of economic growth because it determines the performance of a supply chain, market accessibility, and productivity in general (Economia Aziendale Online, 2024).

The more developed countries in terms of logistics performance are the countries that have a higher degree of trade competitiveness because they can save on delays and uncertainty in international transactions due to the efficiency of the infrastructure and services (Arvis et al., 2024). But the correlation of logistics performance and trade is not a linear correlation. The effect of particular dimensions of logistics is also suggested to be different in relation to the country size, economic organisation, and institutional environments (Wang et al., 2024). As an example, infrastructure quality can have a profound impact on the trade of big economies, and other aspects like tracking or shipment efficiency can play a smaller role in given situations.

2.3 Digital Technologies in International Logistics

2.3.1 From digital tools to integrated logistics systems

The recent literature considers digital technologies in the international logistics field not as one-on-one tools but as a more or less interdependent structure that transforms cross-border coordination, visibility, and control. The latter tends to mention IoT, AI, blockchain, automation and data integration as the fundamental building blocks of so-called smart systems or Logistics 4.0 systems due to their ability to facilitate real-time sensing to make faster decisions and integrate fragmented international supply chains (Idrissi, Lachgar and Hrimech, 2024; Helo & Thai, 2024). But this literature is also

concerned with overdeterministic assertions. According to Atieh et al. (2025), the incorporation of digital technologies into performance is not a priori positive; it is the large deposits that are realised when they are integrated into broader digital change programmes and associated with redesigning organisations. It matters to international logistics, where advantages can be created based on non-hypothetical complete sets of jurisdictions, partners, and legacy systems that may make technological value non-hypothetical.

2.3.2 Core technology clusters and their claimed value

The first group is IoT visibility. According to recent reviews in the open-access, sensors, interconnected devices and tracking platforms reinforce traceability, shipment monitoring and condition control. It can also be especially effective when it comes to international logistics, where distance and complexity at the border reduce transparency (Idrissi, Lachgar and Hrimech, 2024; Samuels, 2025). Visibility is, however, not performance; the abundance of data may enhance monitoring, but does not necessarily increase cost efficiency and reactiveness unless firms have analytical and coordination features for most of that data (Atieh et al., 2025).

A second group deals with AI, analytics and automation. These technologies are largely related to demand forecast, routing optimisation, anomaly detection and operational decision support. They can enhance nimbleness, scalability and logistical productivity (Samuels, 2025; Chen et al., 2024). The evidence is disproportionate, nevertheless. Automation and data integration, as compared to overall digital technology, had a more direct performance impact as reported by Atieh et al. (2025) and could be more strongly discussed by the managerial discourse unless the separate impact of AI is accompanied by process integration and the maturity of process transformation. That is, AI can also be used to improve the judgement of logistics, yet structural bottlenecks (including poor interoperability or fragmented governance) are not removed.

The third group is blockchain and associated trust technologies. Accessible research consistently presents blockchain as useful with regard to traceability, data integrity, document security and smart-contract operations within complicated logistics chains (Idrissi, Lachgar and Hrimech, 2024; Abdullah & Alani, 2025). It is quite pertinent, especially in

international trade, where cross-border trade is plagued by a lack of documentation and information asymmetry. Nevertheless, there is no hyperbole in the literature: blockchain seems to be contributing more to transparency and trust than to the efficient operation on a large scale, and various reviews indicate that the persistent issues of scalability, interoperability and cost of implementation remain a concern (Fareed et al., 2024; Abdullah & Alani, 2025).

2.3.3 Critical issues in adoption and research

According to systematic reviews, companies implement AI, IoT, and blockchain combos, but numerous studies still consider each of the technologies individually, which restricts the knowledge of the effects of integrated digital ecosystems on the final results of the logistics (Fareed et al., 2024; Samuels, 2025). Moreover, new research points out adoption to be disproportional due to the persistence of infrastructure gaps, cybersecurity threats, regulatory fragmentation, lack of skills and data-sharing resistance across international and multimodal activities (Fareed et al., 2024; Atieh et al., 2025). In line with this, digital technologies are to be theorised not as solutions, which are applicable across the board, but as situational facilitators, the logistics value of which relies on organisational preparedness, interoperability and strategic congruence.

2.4 Digital Technologies and Logistics Capabilities

2.4.1 Visibility and information-processing capability

One capability is visibility. IoT, networked places and information-sharing systems increase the capacity of firms to feel the status of shipments, inventory levels and network failures across borders, enhancing the ability to process information in complicated logistics settings (Tiwari et al., 2024; Samuels, 2025). Organisation information processing studies evidence that visibility is not simply a product of digitalisation; it is a staple resource that makes digital capabilities operate with uncertainty (Tiwari et al., 2024). Similarly, a study of digital capability in EV supply chains reveals that the resilience gains of a digital transformation are directed to a large extent via enhanced visibility and cooperation rather than via the own ownership of technology (Li and Sukhotu, 2025).

This is a significant rectification of technology-focused accounts. A lot of literature from previous years suggested that greater use of digital tools automatically enhances the performance of logistics, but recent literature is more sensitive. As Atieh et al. (2025) demonstrate, the direct impact of digital technology alone was not substantial and meaningful, but both automation and data integration played a stronger role as part of the larger digital transformation programs. This indicates that skills development, particularly the capacity to work with, assimilate and synthesise data, is more relational than mere technology acquisition. Visibility without interpretation or integration can make the data volume in international logistics grow, but it does not significantly enhance execution in a system where coordination across firms, borders and modes is hard.

2.4.2 Integration, coordination and decision-support capability

A second group of capabilities deals with integration and coordination. Recent empirical studies have demonstrated that digitalisation enhances the integration of the supply chain because it helps to improve information flows across organisational borders, and that the integration, in turn, moderates the impact of digital transformation on resilience and performance (Yu et al., 2025; Turkeș, 2025). It is very applicable to international logistics where fragmented actors, documentation demand and border processes render the ability to coordinate to be strategically relevant. Logistics IT studies in small businesses also indicate that digital tools enhance the performance of distribution in the SMEs partially by enhancing buyer-seller network relationships instead of having direct impacts on all performance dimensions (Omoruyi et al., 2025).

AI is not considered so much as the generic intelligence as it performs application-specified predictive and optimisation tasks, including anomaly detection, route modification and the creation of recommendations in real-time (Pan et al., 2025). In the same manner, digital twins are increasingly being presented as capability-up sourcing tools since they have the capacity to monitor, predict, back optimisation, control and adaptation throughout logistics processes (Liu et al., 2024). However, of greater concern here is that such technologies can only increase the decision quality when firms have complementary capabilities like skills in analysis, interoperable systems and governance routines. Oncioiu et al. (2025) make a clear argument based on AI-enabling logistics change, which

is subject to infrastructure improvement, but requires a strategic vision, versatile organisational culture and decision support preparedness. An implication of this is that decision support capability is socio-technological: the interaction of tools, routines and managerial competence rather than software only wins the game.

2.4.3 Resilience, agility and the limits of capability formation

The third ability usually associated with digital technologies is resilience, which may be active with agility and recovery capacity. According to recent research, information-processing capacity, efficiency in inventory turnover, and risk management and inter-firm coordination are always improved by digital transformation to enhance resilience (Li et al., 2025; Tian & Cui, 2025; Turkeș et al., 2025). Nonetheless, this literature reveals that the formation of capabilities is uneven as well. Yu et al. (2025) conclude that the resilience value of digital transformation is enhanced when there is more uncertainty in the environment, and the findings of heterogeneity suggest that the type of a firm and the competitive environment determine the results. It implies that digital technologies are not capable of producing homogeneous logistics strengths across companies or industries.

Li et al. (2025) state that digital infrastructure capability, digital analytics capability and strategic support capability do not have the same impact on each other, and they should not be condensed into a single variable. Ardolino et al. (2025) also demonstrate that technologies allow capabilities in various case scenarios, which means that the creation of logistics capabilities is related to time and context. Thus, the most compelling addition is that digital technologies are facilitating the capability of logistics in terms of visibility, integration, collaboration, decision support and resilience, but the impact of this change depends on organisational preparedness and complementary skills and transformation maturity.

2.5 Impact of Digital Technologies on Logistics Performance

2.5.1 Efficiency, speed and operational control

Recent papers have mostly concluded that digital technologies increase the performance of logistics through better operational performance, visibility and process control,

although with uneven effects by technology combination and maturity of implementation. The recurring implications of IoT, AI, data analytics, and automation are linked to real-time information capture, speed of decision-making and enhanced responses to interruptions in the logistics processes, particularly when the firms have an exposure to cross-border complexity and are exposed to disruption (Atieh et al., 2025; Samuels, 2025; Helo & Thai, 2024). Atieh et al. (2025) are especially valuable, as they demonstrate that automation contributed the most to their model, but the importance of data integration and digital transformation is also significant, which implies that quantifiable improvements in logistics performance are less about the availability of technology and more about the turn of technology and operational reorganisation.

This aspect is a decisive one as certain literature continues to depict digitalisation as a broadly speaking positive force behind the logistics performance. Digital technologies have the potential to minimise the delays, enhance resource utilisation and help to coordinate the shipments better, but the benefits are typically conditional on the condition of interoperability, process redesign, and managerial skills rather than the technologies themselves (Atieh et al., 2025; Mvubu & Naude, 2024). Differently put, digital investment is not guaranteed to yield a similar proportional improvement in technical sophistication without a concomitant improvement in logistics in the event that the systems are still fissured or ill-integrated.

2.5.2 Resilience, flexibility and performance under disruption

A second important theme is how digital technologies are changing the dimensions of resilience and flexibility, which have emerged as central dimensions of logistics performance, as opposed to outcomes. According to the latest open-access research, it is stated that digital transformation has a substantial beneficial impact on supply chain resilience through enhancing the levels of information transparency, coordination, and capacity to respond to risks (Li et al., 2025; Yu et al., 2025). Similar arguments put forward by Samuels (2025) are that integrated AI, blockchain, and IoT enhance resilience by analysing risks in a predictive manner, traceability and adaptive decision-making, especially in turbulent market environments. The significance of these results is that they bring the

discussion out of the cost and speed approach towards the larger capability of the logistics systems, to survive under stress.

The correlation is, however, not linear. Research indicates that digital transformation enhances resilience in a more effective way in companies or environments that are more uncertain, better integrated and more digitally prepared; in other words, the effect is not equally effective in all environments (Yu et al., 2025; Alquraish, 2025). This undermines naive arguments that information technologies will automatically introduce lean logistics systems. Rather, there is an indication that organisational and network conditions, such as quality of integration, governance and absorptive capacity, mediate gains of resilience.

2.5.3 Sustainability gains and performance trade-offs

More recent studies also associate digital technologies with performance related to sustainability regarding logistics. Multimodal logistics reviews and a general transformation of the supply chain say that innovative digital technologies have the potential to enhance the routing process, cut waste and make a more sustainable and efficient use of the resources, and improve the definition of the entire concept of logistics performance along with better measures (Fareed et al., 2024; Samuels, 2025). Dalain et al. (2025) append that technological innovation mediated by AI enhances the adaptability, efficiency and strategic flexibility, which may reinforce operational as well as the long-term performance.

Cybersecurity, upskilling the workforce and interoperability are listed in the same literature as chronic obstacles, having the potential to water down or slow projected performance improvements (Samuels, 2025; Mvubu & Naude, 2024). As such, the best solution is that digital technologies do positively influence logistics performance, but in a contingent and multidimensional way and are mediated by transformation capacity. The greatest performance improvements are achieved in the cases when digital tools are incorporated into broader organisational systems, rather than deployed as isolated technical solutions.

2.6 Barriers and Enablers of Technology Adoption in Logistics

2.6.1 Organisational and capability-related barriers

The reports on third-party logistics providers and the wider digitalisation of supply-chain processes have found time and again that weak leadership commitment, lack of strategic alignment, change resistance, and lack of digital skills are the main bottlenecks to adoption (Mvubu and Naude, 2024; Haman et al., 2025). It is a serious fact, since technology is generally put forward as a plug-in technology; however, the clues suggest that implementation breaks down when companies have no managerial intent and capability-crafting systems. Digital tools in particular need to be integrated into new routines, training systems, and cross-functional structures of coordination systems, but are not necessarily purchased and installed ready to be used in logistics settings, particularly the international ones (Mvubu and Naude, 2024; Zeng et al., 2025).

Poor human capacity, insufficient knowledge about the benefits of digital and organisational resistance support each other, and therefore implementation becomes more fragmented and slower than many models of innovation suggest (Rejeb et al., 2024; Zeng et al., 2025). This means that it is not possible to have isolated variables in the form of barriers. Rather, they create a mutually supporting network where a lack of digital literacy and internal opposition may diminish the worth of the most expensive technology initiatives. These findings have a lot of applicability in the context of the proposed study in the area of logistics capabilities, as they suggest that the adoption is contingent upon the ability of firms to turn digital tools into a usable operational competence as opposed to a technical infrastructure.

2.6.2 Technological, financial and regulatory constraints

The second category of barriers is the technological complexity, integration challenges, financial challenges, and regulation. Reviewed articles on IoT and digitalisation in logistics regularly indicate that low interoperability rates with legacy systems, bad data quality, cybersecurity issues and technical complexity continue to be the main barriers to implementation (Rejeb et al., 2024; Ahmad et al., 2024). Such difficulties are particularly sharp in the field of logistics as the operations rely on various actors, data standards, and

transnational processes. In turn, the adoption issue is no longer on the issue of whether a technology performs in principle but rather on the issue of whether the technology can fit into disjointed logistics values without introducing new inefficiencies (Zeng et al., 2025; Mvubu and Naude, 2024).

These technical barriers are worsened by financial and regulatory issues. There remains high initial investment, lack of certainty on returns on investment and imbalanced digital infrastructure as a deterrent to adoption, especially amongst smaller logistic firms and firms operating in a developing environment (Mvubu and Naude, 2024; Zeng et al., 2025). Simultaneously, the regulatory compliance and the lack of harmonised standards are once again cited as key obstacles to the research of the IoT and digitalisation in general (Rejeb et al., 2024; Ahmad et al., 2024). This dilutes the general belief that adoption is more of a managerial option. As a matter of fact, the external environment usually limits adoption by raising compliance costs and decreasing cross-jurisdiction interoperability.

2.6.3 Enablers and the conditions for successful adoption

Leadership support, strategic alignment, workforce development, stable data governance and inter-organisational collaboration were the strongest enablers that have been found in the recent literature (Mvubu and Naude, 2024; Zeng et al., 2025). These considerations are important since they make technologies less uncertain and assist firms in using technology investment objectives for operational goals. Transparency, traceability, smart contracts, and stakeholder trust have also been positioned as relevant enabling factors in the logistics research related to blockchain, especially in cases where a combination of multiple supply-chain participants needs to be coordinated (Abdullah & Alani, 2025).

Nonetheless, the literature is keen enough to emphasise that these enablers are only effective when used together. As an example, an excellent infrastructure when organisations are not ready is inadequate, as management backing and black and white systems do not result in more than symbolic digitalisation (Mvubu and Naude, 2024; Haman et al., 2025). In general, the latest evidence confirms a harsh conclusion: the technologically innovative adoption in logistics is not determined by the features of technologies but the interplay of organisational, technological and environmental factors. This renders the

Technology-Organisation-Environment perspective particularly compelling, as it allows understanding the reason behind the dissimilar results of adoption in various logistics environments when similar technologies are used (Zeng et al., 2025; Haman et al., 2025).

2.7 Theoretical Framework

2.7.1 Resource-Based View (RBV)

The main ground is presented by the Resource-Based View (RBV), which conceptualises digital technologies, including IoT, AI, blockchain and analytics, as strategic resources. They will create a competitive advantage when they are not only valuable but also rare and hard to imitate (Wamba, 2022). Nonetheless, RBV is not sufficient on its own since the technological aspect does not positively affect performance directly but rather makes its contribution through the creation of organisational abilities, including visibility, data integration, and decision-making (Atieh et al., 2025). This is consistent with the mediation of the logistics capabilities considered as a mechanism between technology and performance in this study.

2.7.2 Transaction Cost Economics (TCE)

The TCE perspective supplements RBV, explaining how digital technologies bring costs of coordination down, the information asymmetry, as well as uncertainty in international logistical operations (Williamson, 1985; Idrissi, Lachgar and Hrimech, 2024). In the cross-border logistics, where there are various actors that participate in transactions and transaction complexities, blockchain technology and digital platforms can increase transparency and trust and reduce transaction costs. Nevertheless, TCE also stresses that the cost of implementation, governance and integration is also new in the process of adoption, which is why the outcomes of digital transformation are not evenly distributed among organisations.

2.7.3 Diffusion of Innovation (DOI)

The Diffusion of Innovation (DOI) theory further elaborates the adoption process by emphasising how the organisational readiness, perceived benefits, complexity and externality pressures affect the adoption of technology (Rogers, 2003). DOI is especially

applicable to international logistics, which are more widely adopted by different firms and regions because of the differences in infrastructure, skills and institutional environment.

Combining RBV, TCE and DOI clarifies that digital technologies can enhance the performance of logistics, not directly, but through the development of capabilities, reduction of costs and adoption processes under a certain organisational and environmental condition.

2.8 Research Gap

The analysis of the existing literature shows that there are major gaps in the literature that should have motivated the study. To begin with, the central drawback is the tendency to discuss each of the digital technologies separately, i.e., IoT, AI or blockchain, instead of discussing their interactive and combined impact on the international logistics performance (Idrissi, Lachgar and Hrimech, 2024; Fareed et al., 2024). Such a small scope limits knowledge of the mechanisms of operating integrated digital ecosystems within actual logistics systems, especially those operating in a complex cross-border context.

Second, despite substantial evidence of the effect of digital technologies on higher logistics outcomes, there is inconsistent and context-dependent literature. Other works address high-efficiency gains, cost reduction and response, whereas others see little or indirect effects, usually through the medium of organisational preparedness and integration capability (Atieh et al., 2025; Yu et al., 2025). This implies that technology adoption logistics performance is not linear, yet many studies still assume a direct cause-oriented study without sufficiently taking into consideration the mediating mechanisms.

Third, there is a glaring absence of studies that formally bring the organisational capabilities, including visibility, coordination and decision support, into the technology-performance association. Although the verified capability-based approaches are recognised, there is a lack of systematic actions of relating digital technologies to the logistics capabilities and subsequently to the effects on performance in a single framework. This is one of the weaknesses in the theoretical gap that is bridged in this paper.

Lastly, the literature on barriers and enablers is still descriptive as compared to a comparative study, with a little evidence as regards the variance of these factors in terms of organisational, technological and regulatory circumstances. That restricts the possibility of coming up with generalisable findings to the international logistics systems, where heterogeneity becomes an a priori feature.

2.9 Chapter Conclusion

The chapter has critically analysed the conceptualisation of logistics performance, the role of digital technologies, capacity building, performance implications, and the adverse effects of adoption. It confirms that digital technologies have an indirect effect on the performance of logistics as a result of organisational and contextual parameters. To fill the abovementioned gaps, the study uses an integrative approach in an attempt to offer more comprehensive and theoretically based insight into technology-enabled international logistics performance.

Chapter 03: Research Methodology

3.1 Chapter Introduction

In this chapter, the methodological framework used to investigate the effects of digital technologies on the performance of international logistics in terms of organisational capabilities is presented. It illustrates the philosophical position, the research methodology, strategy, and data collection and analysis methods. Since digital transformation in logistics is more complex and context-specific, a qualitative and interpretive research approach is used to synthesise the existing literature in a systematic manner. The secondary data and thematic analysis have also been justified in terms of how it is applicable in the chapter to support the research objectives. Lastly, the ethical principles that will guide the research process are addressed to maintain academic integrity, transparency and dependability in the course of research.

3.2 Research Philosophy

This work follows the interpretivist research philosophy because the research aims to comprehend the role of digital technologies in improving the performance of international logistics based on the organisational capabilities in diverse contexts. Interpretivism presupposes that reality is constructed and manipulated by social practices of the organisations, the level of technological maturity, and environmental factors, instead of being objectively measured (Saunders et al., 2019). Human decision-making, institutional structure, and intercultural complexity in international logistics impact the performance outcomes that include efficiency, resilience, and flexibility, and thus, an entirely positivist approach cannot be applicable. The approach of interpretivism is especially suitable, as the research is based on secondary literature where various interpretations of the technological adoption and the result of performance in various regions and industries are presented. It allows the researcher to interpret patterns, contradictions, and differences in context critically into the existing studies (Creswell, 2014). Moreover, the previous studies emphasise that the effect of digital technologies depends on the organisational preparedness and integration capacity and is not always deterministic (Atieh et

al., 2025). Thus, an interpretivist approach enables one to get a better idea of how meaning is constructed around technology-enabled logistics performance as opposed to measuring causal relationships.

3.3 Research Approach

The research method applied in the study is an inductive approach of research since it does not require any premeditated assumptions, but rather the development of conceptual knowledge based on the current literature. Induction should be used in cases where research aims to examine the relationships, trends, and new themes in complicated phenomena like digital transformation in logistics (Eisenhardt et al., 2016). Since much of what has been written about the technologies of AI, IoT, and blockchain mainly focuses on them individually, an inductive approach allows merging various results into a consistent analytical system. This strategy will enable the themes in the domain of technology, organisational capabilities, and logistics performance to be extracted from the data itself. This is especially warranted since the digital technologies-logistics performance relationships are non-linear and conditional on contextual elements like organisational preparedness and regulatory settings (Li, Chen, et al., 2025). Instead of assuming strict theoretical notions, induction contributes to theory building by discovering common patterns in the studies. This fits the aims of the study, which is to synthesise dispersed knowledge and create a holistic perspective of the impacts of digital technologies on international logistics' performance based on the development of capabilities.

3.4 Research Strategy

A qualitative research approach is taken with the help of thematic analysis to generalise secondary data from available literature. This type of qualitative strategy is appropriate when the study would examine processes, relationships, and contextual dynamics instead of numerical variables (Saunders et al., 2019). Qualitative analysis is more informative than quantitative approaches in the context of international logistics, where performance outcomes have a multitude of interacting factors like technology integration, organisational capabilities and external environments. It should specifically be thematic analysis since it will allow identifying commonalities in various studies and allow them

to make sense of disjointed research (Braun and Clarke, 2021). This is imperative considering that the literature on the subject frequently focuses on technologies and performance outcomes individually. Using a systematic coding approach, the research reveals the themes, which include visibility, integration, decision-making capability, and resilience. The approach guarantees that it has methodological rigour, yet it remains flexible when analysing complex and heterogeneous data sources. As a result, the qualitative thematic method corresponds to the research goal of creating a combined concept of logistics performance, which is technology-enabled.

3.5 Research Data Collection

The research is also based purely on the secondary data, comprised of peer-reviewed journal articles, industry reports, and publications of the international organisations (World Bank and UNCTAD). The use of secondary data is suitable because numerous scholarly and industry studies on the topic of digital technologies in logistics can be found in various settings and locations (Johnston, 2017). It allows the study to be based on a vast quantity of empirical evidence without being limited by time, cost and access that are involved in primary data collection. The standard applied in the selection of the sources is thorough inclusion criteria with a focus on recent, credible, and relevant publications to guarantee the validity and reliability of the work. Specific attention is given to works that discuss digital technologies, including AI, IoT, blockchain, and analytics, and their influence on the logistics performance dimensions. Such a method allows the comparison of cross-contexts and increases the generalisability of results. Moreover, past studies show that the results of digital transformation can be highly different based on the environmental and organisational settings (Mvubu and Naude, 2024). Accordingly, secondary data will give a thorough background to analyse varied views and find consistent trends throughout the literature.

3.6 Research Data Analysis

This study uses a six-step thematic analysis model, in line with Braun and Clarke (2021), to efficiently examine the data obtained. The work is initiated by the familiarisation with the literature, and initial coding of the corresponding concepts concerning digital

technologies, logistics possibilities, and performance results. These codes are then identified into larger themes like visibility, integration, decision support and resilience. The thematic analysis is appropriate as it is flexible and can synthesise qualitative information across multiple sources and retain its depth of analysis. It enables the researcher to reveal both prevailing trends and contradictions in the literature, which is crucial considering the mixed results of digital technologies' effects (Atieh et al., 2025). The repetitive aspect of the analysis will guarantee the narrowing of the themes and alignment towards the research objectives and the theory. This practice also helps to combine the insights of RBV, TCE, and DOI and view the impact of digital technologies on logistics performance through organisational capabilities holistically.

3.7 Ethical Consideration

Ethical issues are also considered beforehand in order to provide the integrity and credibility of the research. Since the research is based on secondary data, concerns regarding informed consent and participant confidentiality do not come into play. But ethical accountability is ensured due to the inclusion of all sources referenced and the lack of plagiarism and intellectual misconduct (Saunders et al., 2019). The research makes sure that all the data used is obtained from publicly accessible and trustworthy sources, such as peer-reviewed journals and institutional reports of good reputation. This reduces the chances of misinformation and adopts reliability of findings. Furthermore, the researcher assumes an open-minded and objective one in analysing and interpreting data, so that results are not carefully chosen and reported. Since research on digital transformation could be hit by the commercial and strategic implications, precautions are observed to ensure a balanced and evidence-based conclusion is presented. In general, the research complies with the requirements of the set ethical standards because of the adherence to academic integrity, transparency, responsible use of data, etc.

3.8 Chapter Conclusion

This chapter has contained a systematic methodology that is in tandem with the research aim and objectives. Through the use of an inductive method and an interpretivist philosophy, the research will allow understanding the relationship between digital

technologies and logistics performance in more detail in the specific context. The thematic analysis of the secondary data, aided by the qualitative strategy, offers a legitimate structure in which the various findings are synthesised. Moreover, ethical standards should be taken into account properly, which will guarantee the research's credibility and integrity. On the whole, the selected methodology provides a strong basis for examining the role of digital technologies in the performance of international logistics based on organisational capabilities in further chapters.

Chapter 04: Findings and Analysis

4.1 Chapter Introduction

The current chapter presents the results of the investigation in the form of a thematic analysis of the literature that has been chosen. The analysis is organised around key themes as part of the research objectives and conceptual framework, that is, digital technologies in logistics, digital transformation and integration, organisational capabilities, logistics performance outcomes, and barriers and enablers of technology adoption. The aim is to synthesise existing knowledge and critically review the impacts of digital technologies on international logistics performance by developing organisational capabilities. The chapter gives a complete view of technology adoption-capability formation-performance outcomes relationships in international logistics based on information derived from various studies.

Theme	Sub-Themes	Key Findings from Literature	Sources	Link to Research Questions
1. Digital Technologies in Logistics	IoT (tracking & visibility)	Enables real-time tracking, improves transparency and traceability across supply chains.	Idrissi et al. (2024); Helo and Thai (2024)	RQ1
	Artificial Intelligence (AI)	Enhances demand forecasting, route optimisation, and anomaly detection	Nalbantoğlu (2025); Chen et al. (2024)	RQ1, RQ2
	Blockchain	Improves data security, transparency, and trust among supply chain partners	Abdullah and Alani (2025); Fareed et al. (2024)	RQ1, RQ2

	Big Data Analytics	Supports data-driven decision-making and predictive insights	Samuels (2025); Atieh et al. (2025)	RQ1, RQ2
	Automation & TMS	Improves operational efficiency and reduces human error	Atieh et al. (2025)	RQ1, RQ2
2. Digital Transformation & Integration	Integrated logistics systems	Technologies create interconnected and responsive logistics networks (Logistics 4.0)	Helo and Thai (2024); Nouhaila and Hamid (2025)	RQ2
	Data integration	Performance improvements depend on system integration, not isolated technologies.	Atieh et al. (2025)	RQ2
	Process redesign	Technology impact is stronger when combined with organisational transformation.	Mvubu and Naude (2024)	RQ2
3. Organisational Capabilities (Mediators)	Visibility capability	Real-time information enhances monitoring and responsiveness	Tiwari et al. (2024); Li and Sukhotu (2025)	RQ3
	Integration & coordination	Digital tools improve collaboration across supply chain actors	Yu et al. (2025); Turkeș (2025)	RQ3
	Decision-support capability	AI and analytics improve decision-making and operational control	Pan et al. (2025); Oncioiu et al. (2025)	RQ3
	Resilience & agility	Digitalisation strengthens risk management and adaptability	Li et al. (2025); Tian and Cui (2025)	RQ3

4. Impact on Logistics Performance	Cost efficiency	Digital technologies reduce operational costs and improve resource utilisation.	Atieh et al. (2025); Mvubu and Naude (2024)	RQ2
	Timeliness & speed	Real-time data improves delivery speed and reduces delays	Samuels (2025); Helo and Thai (2024)	RQ2
	Reliability	Improved coordination increases delivery accuracy and consistency	Chen et al. (2024); Yu et al. (2025)	RQ2
	Flexibility & resilience	Enables adaptation to disruptions and market changes	Li et al. (2025); Alquraish (2025)	RQ2
	Sustainability	Optimisation reduces waste and environmental impact	Fareed et al. (2024); Dalain et al. (2025)	RQ2
5. Barriers to Technology Adoption	Organisational barriers	Resistance to change, lack of skills and leadership support	Mvubu and Naude (2024); Haman et al. (2025)	RQ4
	Technological barriers	Interoperability issues, cybersecurity risks, and system complexity	Rejeb et al. (2024); Ahmad et al. (2024)	RQ4
	Financial barriers	High investment costs and uncertain ROI	Zeng et al. (2025); Mvubu and Naude (2024)	RQ4
	Regulatory barriers	Lack of standardisation and cross-border compliance issues	Ahmad et al. (2024); Zeng et al. (2025)	RQ4

6. Enablers of Technology Adoption	Leadership & strategy	Strong leadership and strategic alignment drive adoption success	Mvubu and Naude (2024)	RQ4
	Skills & workforce development	Digital skills enable effective technology utilisation	Rejeb et al. (2024)	RQ4
	Infrastructure & data governance	Robust IT systems and data management improve implementation	Zeng et al. (2025)	RQ4
	Collaboration & trust	Inter-organisational cooperation enhances integration and performance	Abdullah and Alani (2025)	RQ4

Table 1: Thematic Analysis Table (Source- Author)

4.2 Digital Technologies in International Logistics

Digital technologies have also been at the heart of the change in the logistics of international markets and have redefined the way goods, information and services shift into and out of global supply chains. A collection of core technologies that essentially appear in the literature as the Internet of Things (IoT), artificial intelligence (AI), blockchain, big data analytics, and automation are all major enablers of digital logistics systems identified. These technologies are finding more applications as what has been imagined as logistics 4.0, typified by systems that are interconnected, intelligent processes and data-driven decisions. Nevertheless, as much as the potential of these technologies is a well-respected topic, they do not influence the logistic performance uniformly, and as such, they are reliant on the organisational preparedness, capability to integrate, and the contextual elements as well. International logistics networks are becoming increasingly visible and traceable, depending on the Internet of Things. Connected sensors and devices powered by IoT permit tracking shipments and monitoring of the environment in real-time, as well as automated data capture within the supply chain. This functionality is

especially useful in global logistics, when the multimodal and cross-border operations tend to impose visibility disjunctions owing to the geographical spread. Real-time monitoring helps companies to identify disruptions earlier on, enhance the coordination process, and minimise doubt in delivery schedules (Idrissi et al., 2024). However, according to the literature, the presence of data produced by IoT does not ensure better performance. The worth of IoT is determined by how an organisation can process and effectively behave on the generated data, implying that the capability of data utilisation is crucial as much as data generation. Another key digital technology that is changing logistics operations is artificial intelligence. Machine learning and predictive analytics are AI technologies to assist with demand forecasting, route optimisation, and risk assessment. These functions can allow companies to make their decisions faster and more accurately, and, therefore, more efficiently and responsive in their operations. An example is the use of AI-controlled systems that can optimise transportation routes in terms of real-time traffic data (faster delivery time and fuel use) (Chen et al., 2024). Nonetheless, adopting AI also poses disadvantages, such as a high-quality of data, advanced analytics, and a change in the organisation. The possible advantages of AI cannot be obtained without an appropriate level of analytical abilities and data infrastructure, showing that the sole solution to improving performance is to invest in technology.

The capacity to improve transparency, security and trust in logistics operations has attracted a lot of attention to the blockchain technology. Blockchain decreases information asymmetry and enhances accountability among supply chain partners by facilitating decentralised and tamper-proof sharing of data. This is especially true when considering the international logistics where different stakeholders such as carriers, customs agencies and middlemen need to share information safely. Blockchain can also support quicker documentation cycles, cut fraud, and provide smart contracts to outperform transactions (Abdullah and Alani, 2025). In spite of these merits, the mass use of the blockchain is restricted by issues like scalability, integration with existing systems, and regulatory ambiguity. As a result, despite the great potential, the practical implications of blockchain are in their infancy. The use of big data analytics is a complement to other digital technologies as it allows firms to obtain meaningful insights from large and

complex datasets. With sophisticated analytics, organisations are able to recognise trends, predict demand, and streamline logistics operations. By incorporating big data analytics into IoT and AI, firms will have greater predictive potential because they can act before disruptions and respond swiftly (Samuels, 2025). Nonetheless, it remains that the quality of data, integration, and governance is the key to analytics efficiency. Weak data management practices can decrease the usefulness of analytics, hence the significance of having well-developed data infrastructure and data governance systems. Automation technologies (such as automated warehouses, automated robotic processes) are also part of the efficiency of operations, as they decrease human involvement and reduce the number of errors. Automation has the potential to enhance speed, accuracy, and consistency in logistics activities, especially warehousing and inventory management. Automation, however, can be costly, and it can typically necessitate organisational restructuring, which can be difficult to accomplish by a smaller firm. Furthermore, automation works best in combination with other digital technologies, instead of being used separately (Atieh et al., 2025). The common thread of the literature is that digital technologies are not often used on their own, but their usefulness is optimised when they are a part of comprehensive digital ecosystems. IoT, AI, blockchain, and analytics together make it possible to have end-to-end visibility, smart decision-making, and smooth coordination throughout the supply chains. However, the interoperability issues, such as legacy systems and data silos, make integration a major challenge. Research underlines that digital technologies adoption must be strategically aligned and redesign processes as well as change organisational structure.

4.3 Digital Transformation and Integration

Digital transformation in international logistics is a complete integration of digital technologies, processes, and organisational designs to improve operational effectiveness, responsiveness, and strategic decision-making. As pointed out in the literature, the digital transformation extends beyond the implementation of single technologies and is a systemic change in the design, coordination, and execution of logistics activities. Here, digital transformation is directly connected to the term Logistics 4.0, which puts strong emphasis on establishing cyber-physical systems and real-time information transfer,

automation, and intelligent decision-support systems to establish more responsive and effective logistics systems. An important lesson provided within the literature is that digital transformation in logistics is not just a technological improvement but a change in the structure and organisation. Redesigned business processes and organisational capabilities should support the adoption of new and advanced technologies like the Internet of Things (IoT), artificial intelligence, blockchain, and big data analytics. The possible advantages of digital technologies are constrained without such integration. Several studies assert that single technology implementation in most cases leads to fragmentation and the emergence of minimal performance benefits as technologies do not synergise with current operations as well as organisational practices (Atieh et al., 2025). An essential part of digital transformation in global logistics is data integration. Information is flowing smoothly through various phases of the supply chain as integrated data systems allow the company to coordinate and minimise inefficiencies. In international logistics, which involves different parties such as manufacturers, logistical providers, customs authorities and customers, the presence of integrated data systems helps to alleviate the information asymmetry and ensures better decision-making. As mentioned in the literature, the greatest success of digital transformation is achieved when the data is not only gathered but also shared and analysed beyond the organisational level (Helo and Thai, 2024). This degree of integration improves visibility, real-time decision making, and minimises delays that occur due to disintegrated information systems.

The other critical component of digital transformation is process redesign. Digital technologies usually force organisations to redefine the past logistics processes, workflows and governance structures. To illustrate this, the introduction of AI-based decision-making systems will require an adjustment in operational planning and managerial functions. On the same note, blockchain and documentation, as well as smart contracts, involve data sharing protocols and transaction management. Organisations might not achieve maximum use of digital capabilities unless the business processes are aligned with digital capabilities. Research has shown that companies that undertake process redesign and the adoption of technology get much better performance results than companies that only invest in technology (Mvubu and Naude, 2024). In a successful digital

transformation, organisational alignment is very important. The effectiveness of the digital initiatives depends greatly on leadership commitment, strategic vision, and the organisational culture. Effective leadership sponsorship will put digital transformation initiatives in line with the wider organisational goals and provide the resources needed to support them. On the other hand, opposition to changes, limited digital aptitudes and poor governance systems may thwart integration. The digital transformation is highlighted in the literature as much of a managerial as it is a technological issue, necessitating the coordination of efforts on various organisational levels.

4.4 Organisational Capabilities as Mediators

The evidence in the literature is overwhelming that organisational capabilities are one of the key mediating variables of the effects of digital technologies on international logistics performance. Instead of making direct contributions to the outcome, digital technologies can empower the emergence of abilities that can enable firms to work more efficiently in the complicated supply chains around the globe. These functionalities are visibility, integration and coordination, decision-support, and resilience, all of which can be used to determine how adoption of technology can result in quantifiable performance gains. A visibility capability is one of the most apparent consequences of digitalisation. Using Internet of Things (IoT) gadgets, sensor technologies and real-time tracking, companies can track shipments, inventory, and transport through networks that can be located geographically far apart. This increased visibility allows organisations to mitigate disruptions beforehand, enhance the reliability of shipment and minimise perception of uncertainty in delivery practices. Nonetheless, the literature indicates that visibility is not enough to spur performance benefits unless the firms also have, as far as real-time information is concerned, the ability to read it and implement it. This means that visibility should be underpinned by data processing and analytical capabilities, as organisations are forced to build analytical competencies in order to transform raw data into actionable insights. Capabilities of integration and coordination are also critical in the mediation of the relationship between digital technologies and logistics performance. The international logistics networks can be described as the context in which the interaction between various actors occurs, such as the suppliers, logistics providers,

regulators and customers. Cloud-based platforms, enterprise systems, and blockchain technology allow information sharing across all stakeholders, which facilitates coordination at minimal cost and improves the decision-making process. Research indicates that optimisation of logistics activities and supply chain efficiency is enhanced in companies with a good integration capability, which also has lower delays. On the other hand, inadequate integration forms a barrier to the potential advantages of digital technologies, as data silos and incompatible systems prevent collaboration.

Predictive and prescriptive insights based on artificial intelligence and sophisticated analytics tools are helpful in operational and strategic decision-making. Firms are able to optimise routing and manage inventory, forecast demand, and proactively respond to disruptions using these technologies. But the success of AI-based decision-support systems is strongly intertwined with the organisational considerations of managerial experience, quality of data and types of governance. The possibility of AI to enhance decision-making can go to waste without sufficient analytical abilities and organisational preparedness. In the literature, the importance of resilience and agility capabilities as critical outcomes of digital transformation is gaining more and more prominence. Such qualities as rapid response to disruptions, the possibility to adjust to the changing market conditions, and the continuity of operation are especially valuable in global logistics, where uncertainty and volatility are usual. Digital technologies can increase resilience, as they provide multi-optimal real-time monitoring, forecasting risk, and quick reconfiguration of logistics processes. However, not only are technological results resilient, but organisational culture, leadership and the capability of coordination among supply chain partners also influence such result.

4.5 Impact on Logistics Performance

Digitisation of technologies influences extensively various aspects of international logistics performance, such as cost efficiency, timeliness, reliability, flexibility, and sustainability. The literature, however, underlines that these effects are dependent on organisational capabilities, degree of integration, and situational factors, instead of being a direct result of the adoption of technology. One of the most popular reported advantages of digitalisation is cost efficiency. Automation, AI, and analytics are used to optimise the

utilisation of resources, decrease operational errors, and minimise waste. Stated differently, predictive analytics and automated warehousing systems help to lower the labour expenses and enhance inventory management. Nevertheless, the literature also informs that initial costs of investment, system integration costs, and training needs can cover the short-term financial returns, especially when it comes to small and medium-sized enterprises. Digital technologies also have a great impact on timeliness and operational speed. Predictive analytics and real-time data collection help provide quicker decision-making and minimise the delays occurring during transportation and distribution. It is especially relevant to international logistics, where time loss can lead to considerable financial and operational losses. Digital technologies also enhance responsiveness through altering the tasks of routes, schedules and inventory levels in real time depending on the evolving conditions. Another important aspect of logistics performance that is seen to benefit from digital transformation is reliability. Enhanced information sharing, tracking, and coordination minimise the level of uncertainty and increase the accuracy of delivery. Customer satisfaction and long-term business relationships. It has been known to promote customer satisfaction and long-term business relationships through the support of reliable logistics operations. Nonetheless, the stability and integration of digital systems determine the reliability. Reliability may be compromised by technical failures, inaccurate data or as a result of poor system integration, which is why strong infrastructure and governance are a priority.

Adaptability and strength have gained greater significance as performance dimensions within the global uncertainty and disturbances. With the help of digital technologies, organisations can be quickly adaptable to the changing conditions, rerouting, and respond in a proactive way to interruptions. However, these benefits differ based on organisational readiness and the digitisation maturity of organisational systems. Another new dimension of logistics performance relating to digital transformation is sustainability. Robots like AI and analytics provide a more efficient method of routing and resource usage, minimising fuel usage and pollution. Digitalisation also helps to create transparency and accountability in sustainable logistics practices. However, the effects of digital

technologies on the environment are not qualitative as they rely on the ways in which technologies are administered and governed.

4.6 Barriers and Enablers of Technology Adoption

The barriers and enablers interact in a complicated way to influence the use of digital technologies in international logistics. These determine how well organisations can achieve success in deploying digital solutions and extracting the fruits. The literature recognises organisational, technological, financial and regulatory factors as determinants of technology adoption. One of the biggest challenges to digital adoption is organisational barriers. Resistance to change, deficient support of the leadership and deficient skills of digital usage often undermine the successful implementation of digital technologies. Employees might be unwilling to accept new systems because it is not yet clear, or they have the fear of being displaced, and managers might lack the required strategic vision needed to spearhead digital transformation. Lack of proper training and low level of digital literacy also limit the proper use of the advanced technologies in order to have more potential on their effect on the performance. Barriers to technology are also very challenging. Digital solutions are commonly restrained in their efficiency by issues pertaining to system interoperability, data quality, cybersecurity, and technical complexity. Most logistics organisations use legacy systems, which are challenging to integrate with the current digital systems. Moreover, the issue of data security and privacy may also deter organisations from embracing cloud-based and data-sharing technologies. These issues are especially acute with international logistics, where configurations of various systems and standards have to be harmonised. There are also financial constraints that limit the adoption of technology, especially for small and medium-sized firms. The initial investment expenditure, lack of certainty on the returns on investment, and continual maintenance costs are some factors that may discourage organisations from undertaking digital transformation initiatives. These problems are complicated by the lack of access to finance and risk aversion, particularly in developing areas.

Technology also assumes regulatory and environmental factors in its adoption. Differences in regulatory frameworks, lack of standardisation, and multifaceted requirements to comply with different jurisdictions create confusion and add to the adoption cost.

Such obstacles make it more difficult to implement technologies like blockchain and cross-border data-sharing platforms. These barriers notwithstanding, there are several enablers that enable successful technology adoption. Good leadership and alignment with the strategy are very important when fighting resistance and making sure that digital initiatives are allied to the objectives of the organisation. The investment in the development of the workforce and digital skills allows organisations to use the newly developed technologies more efficiently. Strong information technology infrastructure and data governance models enable integration and scalability, whereas a partnership with supply chain partners generates trust and information sharing.

4.7 Chapter Conclusion

The chapter has presented an in-depth thematic discussion on the fact that digital technologies can be used to improve the performance of international logistics. The results reveal that despite the potential of digital technologies, their effects rely on the organisational capabilities and depend on the situational factors. The analysis relates the value of integration and capability development and strategic alignment in realising performance improvements. Moreover, the factors of barriers and enablers are also very important in influencing the results of technology adoption. On the whole, the chapter has a somewhat good analytical background to get a better insight into the complicated association between digital technologies and logistics performance, which is to be explored further in the following chapter.

Chapter 05: Discussions

5.1 Chapter Introduction

In this chapter, findings brought about by the thematic analysis that was done in Chapter Four have been discussed in detail. The aim is to explain the results about the conceptual framework and the available theoretical approaches, such as the Resource-Based View (RBV), the Transaction Cost Economics (TCE) and the Diffusion of Innovation (DOI). Connecting the empirical and theoretical constructs, the chapter offers more in-depth information on the impact of digital technologies on international logistics performance using organisational capabilities. There are also more general implications of the findings on the practice of logistics, policy and future research directions.

5.2 Interpretation of Key Findings

5.2.1 Role of Digital Technologies in International Logistics

As the analysis shows, digital technologies become the core of the international logistics transformation based on facilitating visibility, efficiency, transparency, and decision-making. The Internet of Things (IoT), artificial intelligence (AI), blockchain, big data analytics, and automation are identified as some of the core capabilities of modern logistics systems. All these technologies facilitate the operation of traditional logistics operations to intelligent, data-driven, and interconnected supply chain networks (Idrissi et al., 2024; Helo and Thai, 2024). Extensively, IoT technologies are known to enhance real-time locating and tracking of goods and assets, as well as monitoring the conditions of transportation. This can be of high value, especially in international logistics where consignments cross various jurisdictions and means of transport. IoT removes uncertainty, improves coordination, and responsiveness to disruptions by enabling a constant awareness of the shipment status (Idrissi et al., 2024). Nonetheless, the results also show that the relevance of IoT is also subject to whether an organisation can handle and examine enormous amounts of data, which implies that technology is not enough but must be accompanied by analytical functions. Artificial intelligence is also a contributor to the efficiency of operation and decision-making. The AI-based systems can improve demand

predictions, optimal routes, and risk management, enabling companies to make effective and timely decisions (Chen et al., 2024). Although these benefits are noted, data quality, technical skills, and organisational preparedness are issues surrounding the deployments of AI. As a result, the advantages of AI can be achieved only when companies have the data infrastructure and analytical capabilities (Atieh et al., 2025). One of the enablers of transparency and trust in international logistics belongs to blockchain technology. Blockchain minimises the information asymmetry and improves the partnership between supply chain partners by offering secure and immutable documentation of the transactions (Abdullah and Alani, 2025). Its use, however, has not been very widespread because of its scaling, uncertainty in regulations and integrating with old systems. On the whole, the results show that digital technologies play a crucial role in transforming logistics in the international environment. Nevertheless, they do not have automatic effects and the extent to which they are incorporated within organisational systems and processes. This underlines the importance of a strategic approach to technology adoption and not perceiving digital tools as isolated solutions.

5.2.2 Integration and Digital Transformation in Logistics Systems

The results point to the fact that digitalisation of logistics is a systemic phenomenon that goes beyond the implementation of certain technologies. Rather, it is the process of merging technologies, processes and organisational structures to establish integrated and flexible logistics systems. This combined strategy is reflected in the vision of Logistics 4.0, where there is a focus on an interdependent system, exchange of real-time data, and smart decision-making (Helo and Thai, 2024). An important lesson of the study is that the advantages of digital technologies become the greatest when they are built into integrated systems. When technologies are implemented in a fragmented manner, performance gains can often be minimal because single systems do not give a holistic value. Research has always shown the superior performance outcomes of those organisations in which digital technologies are distributed throughout business processes and coordinated across functional areas (Atieh et al., 2025). Data integration proves to be a key to effective digital transformation. Integrated data platforms allow a constant flow of information among the supply chain partners and improve coordination and minimise

inefficiencies. Integrated systems can enhance collaboration and decision-making in the case of international logistics, where various actors will be involved in cross-border logistics. In the absence of such integration, digital technologies may pose further complications, instead of bringing efficiency benefits (Mvubu and Naude, 2024). Moreover, the digital transformation demands organisational change, such as the redesign of processes and cultural adjustment. To successfully use digital technologies, organisations need to reorganise their work processes, redefine jobs, and acquire additional skills. Cultural resistance to change and the absence of strategic orientation are recognised as major obstacles to change. Good leadership and commitment in organisations are thus needed to facilitate successful digital transformation initiatives. Interoperability and standardisation are also important in the findings. Diverse systems and regulatory environments are a challenge towards integration in international logistics. The lack of common standards and compatible systems can hinder the effectiveness of digital solutions. As a result, the cooperation of stakeholders and the use of standardised systems are essential drivers of an effective digital transformation.

5.2.3 Organisational Capabilities as Mediators of Technology Impact

The results are strong evidence that organisational capabilities mediate the correlation between the digital technologies and logistics performance. The result of digital technologies does not create the enhancement of performance per se; instead, it creates the potential of capabilities in terms of visibility, integration, decision-making, and resilience that can produce performance outcomes (Li et al., 2025; Yu et al., 2025). One of the most prominent consequences of digitalisation is the visibility capability. IoT and analytics systems can generate real-time data, which can be used to allow organisations to track supply chain operations and act proactively on disruptions. The visibility, however, is not enough, and organisations are required to have the analysis power to interpret the data and make informed decisions (Tiwari et al., 2024). It is also important that there are integration and coordination capabilities. Digital technologies enhance information sharing and coordination between supply chain partners; this increases their efficiency and effectiveness. Companies that are highly integrated can utilise digital technologies to better their performance (Yu et al., 2025). Strategic and operational decisions on the use

of AI and analytics tools are based on insights obtained. The success of these tools, however, lies in the expertise of the managers, organisational structures and governance processes. In the absence of such capabilities, the possibilities of digital technologies will not be exploited. The capability of resilience and agility has now become prominent in the face of growing uncertainty in the world. Digital technologies help organisations to foresee challenges, react to upheavals and be prepared to deal with evolving circumstances. But these capabilities are developed based on the organisational culture, leadership, and strategic orientation. Generally, the results back up the Resource-Based View, which highlights that competitive advantage is not based on technology but organisational capabilities. The digital technologies should act as enablers, with organisational capabilities defining how much performance uplift should be achieved.

5.2.4 Digital Technologies and Logistics Performance Outcomes

The analysis reveals that digital technologies affect various aspects of logistics performance, such as efficiency in cost, timeliness, reliability, flexibility, and sustainability. But these effects are mediated by organisational capabilities and contextual influences. One of the most common advantages of digitalisation is cost efficiency. Automation and analytics allow companies to streamline using resources, minimise mistakes and operational expenses (Atieh et al., 2025). Digital technologies greatly contribute to timeliness and speed. Real-time data and predictive analytics also allow making decisions quicker and minimising delays in the logistics processes (Samuels, 2025). Enhanced timeliness translates to customer satisfaction and a competitive edge in the global markets. Digital technologies enhance precision and uniformity of the logistic processes through better coordination and information exchange (Chen et al., 2024). However, the reliability is also dependent on the stability and integration of digital systems. Adaptability and stability have gained more significance in the world in the wake of the disruptions. The digital technologies help organisations quickly react to demand, hampering of supply constraints, and regulatory changes. This increases the strength and sustains long-term (Li et al., 2025). Another performance area that is emerging and is linked to digital transformation is sustainability. Optimisation and waste minimisation through digital technologies allow us to use resources more efficiently and have less impact on the environment

(Fareed et al., 2024). Yet, the attainment of sustainability outcomes would need a strategic alignment and long-term commitment.

5.2.5 Barriers and Enablers of Technology Adoption

The results indicate that any implementation of digital technologies in international logistics depends on both barriers and enablers. The factors that affect how much organisations will be able to achieve success in implementing digital solutions and realising their benefits. One of the greatest challenges is organisational barriers. Resistance to change, a deficit of leadership support, and inadequate digital skills are the barriers to the successful adoption of digital technologies (Mvubu and Naude, 2024). The absence of foresight in employees may cause resistance to the new systems, and organisations may not be forward-looking enough to make a successful transition. Barriers caused by technology are also a challenge. The challenges based on interoperability, cybersecurity risks, and technical complexity restrict the efficiency of digital solutions (Rejeb et al., 2024). All these issues are especially acute with international logistics, when various systems and standards need to be matched. There are additional limitations on the adoption due to financial constraints, which constrain small and medium-sized enterprises. Investment in digital technologies is put off by high initial expenses and uncertainties about the returns. Adoption is also hampered by regulatory issues, such as the absence of standardisation and complicated compliance regulations (Ahmad et al., 2024). Although these obstacles are present, some enablers enable successful technology adoption. There is strong leadership and alignment to strategic that facilitates the digital transformation initiatives. Organisational preparedness can be improved by investment in workforce development and digital skills. Scalability and integration are allowed through strong IT infrastructure and data governance structures. The partnership between the supply chain partners also ensures proper implementation through building trust and information exchange (Abdullah and Alani, 2025).

5.3 Linking Findings to the Conceptual Framework

5.3.1 Resource-Based View (RBV) and Capability Development

The results of this paper strongly reflect the Resource-Based View (RBV) that argues the ability to develop and utilise organisational capabilities to maintain a sustainable competitive advantage does not just exist in having resources but also in the capacity to create and utilise them. In the employment of the international logistics field, digital resources, including IoT, analytics, blockchain, and AI, are considered as strategic resources; nevertheless, they are only worth their weight once the companies turn them into higher-order organisational resources (Barney, 1991; Wamba et al., 2017). This also fits into the argument that digital technologies do not have a direct effect on the performance of logistics; however, their effects are mediated by the capabilities of visibility, integration, and decision-making (Atieh et al., 2025). The discussion shows that companies that do an excellent job of establishing visibility principles by means of real-time data gathering and sophisticated analytics will become more responsive and coordinated when it comes to cross-regional supply chains. Nevertheless, RBV underlines that a durable competitive advantage is only achieved when such capabilities are valuable, rare, difficult to imitate, and embedded in organisations (Barney, 1991). To illustrate, as the tools of IoT and analytics become highly available, the capacity to make sense of data, to merge systems, and turn insights into operational choices is a distinct organisational internalisation that distinguishes higher or lower performing firms. The ability to coordinate and integrate also contributes towards the perspective of RBV. Companies that effectively combine digital systems within organisational boundaries establish relational capabilities that are hard to copy by competitors. Those features allow facilitating information sharing and cooperative decision-making, which are essential in global logistics networks where several parties and complicated regulations are prevalent (Yu et al., 2025). The results indicate that the very implementation of technologies like blockchain or AI is unlikely to lead to an improvement in performance, but instead, it is the capacity of the firm to integrate these technologies with the existing resources and routines that is likely to create value.

The applicability of RBV can also be exemplified when using decision-support capabilities made by AI and analytics. These can supplement strategic and operational decision-making processes with predictive insights and optimisation advice. Their success, however, is determined by other organisational resources like qualified human resources, healthy data infrastructure and enabling governance frameworks (Pan et al., 2025). Digital technologies will not bring the result of enduring performance increases unless these complementary resources are in place. In addition, the capabilities of resilience and agility built as a result of digital transformation are dynamic capabilities that help companies adjust to dynamic conditions. This is not in opposition to the adaptability and reconfiguring of resources emphasised by RBV towards maintaining a competitive advantage. On the whole, the results strengthen the idea that digital technologies are strategic enablers, yet it is the maturation of the organisational capabilities that defines the long-term performance results in international logistics.

5.3.2 Transaction Cost Economics (TCE) and Efficiency Outcomes

To gain a deeper insight into the effectiveness of digital technologies in international logistics, the TCE offers a complementary approach. TCE concentrates on the transaction costs such as information search, negotiation, monitoring and enforcement (Williamson, 1985). Geographic dispersion, presence of multiple intermediaries, complexities in regulations, and information asymmetries are common causes of these costs in international logistics. The results show that digital technologies have a high impact in decreasing transaction costs, as they enhance transparency, rules of coordination, and the availability of information. Indicatively, the blockchain technology increases trust and minimises opportunistic behaviour due to immutable records of transactions. This minimises the amount of verification done and reduces costs incurred in monitoring (Abdullah and Alani, 2025). Equally, the digital platforms and data sharing systems decrease the information asymmetry as real-time information exchange between the supply chain partners is provided. Image analytics and AI also play a role in minimising transaction costs through enhanced decision accuracy and less uncertainty. Predictive analytics also allows companies to foresee any changes in demand and optimise the use of resources, thus reducing inefficiency and operational risk (Chen et al., 2024). Robotisation also

minimises transaction costs as it simplifies routine operations and minimises human error, resulting in the achievement of a higher level of operational efficiency (Atieh et al., 2025).

Nevertheless, the TCE implementation also accentuates the fact that digital transformation presents new costs. New transaction costs in the case of digital technologies include implementation costs, integration issues, cybersecurity threats, and governance complexities. The literature states that these expenses could compensate for part of the envisaged efficiency improvement, especially for organisations with few resources or capabilities (Mvubu and Naude, 2024). The results also indicate that the digital technologies influence the transaction costs differently across organisational and environmental contexts. Companies that have a high level of integration and have established networks are more capable of taking advantage of digital technologies in driving down the costs of transactions. On the other hand, organisations in discontinuous environments that have poor interoperability can accrue more complexity and expenses. On the whole, the implementation of TCE in the present study points to the fact that digital technologies may improve efficiency in terms of lowering transaction costs, yet the positive effects are dependent on organisational potential and the existence of governance frameworks, as well as the institutional context in general. This highlights the need to look at the gains and losses of digital transformation in global logistics.

5.3.3 Diffusion of Innovation (DOI) and Adoption Dynamics

The Diffusion of Innovation (DOI) model offers useful information about the processes of adaptation to online technologies within global logistics. DOI elucidates the manner in which innovations are embraced in the course of time, depending on the perceived advantages, complexity, compatibility, trialability and observability (Rogers, 2003). These study results agree with DOI since they show that organisational as well as environmental factors affect technology adoption in logistics. Perceived relative advantage is an important element in the adoption of technologies. Companies are increased to imitate the digital technologies when they can feel distinct advantages in terms of efficiency, low costs and high performance. The use and relevance of AI, IoT, and blockchain technologies are growing because they have the ability to help increase the visibility, coordination,

and decision-making (Idrissi et al., 2024). The perceived benefits are, however, not enough; the organisations also need to consider the issues of the complexity and compatibility of the new technologies with the existing systems. Complexity is detected as an important impeding factor. Tasks where technology needs to be both heavily integrated and technical, and organisational change are slower to implement. This can be observed especially when it comes to blockchain and AI, where complexities of the technical aspects and incompetence are the main barriers to widespread use (Rejeb et al., 2024). Adequacy to current infrastructure and processes is another factor in adoption. Benefit: Organisations will find it easier to use technologies that are supportive of the organisational systems and practices.

Also impactful on adoption dynamics are organisational readiness and absorptive capacity. Organisations that are well-led, have digital capabilities, and positive organisational cultures have higher chances of successful adoption and integration of digital technologies (Mvubu and Naude, 2024). On the other hand, opposition to change and a lack of strategic alignment slow down the adoption processes. Exogenous factors are also key factors in the diffusion of technology. The rate and degree of adoption of technology are affected by regulatory frameworks, the industry standard, and networks. The diffusion of digital innovations can be accelerated or impeded by cross-border regulations and the differences in technological standards in international logistics. Overall, the DOI framework also emphasises that the introduction of digital technologies into international logistics is not a simple process, but it is affected by the perceived value, organisational preparedness, and the specificities of technology, as well as external environmental factors. The results highlight that technological investment, but also organisational and institutional support, is necessary to make this adoption successful.

5.4 Chapter Conclusion

This chapter was the synthesis of the main results of the study and its interpretation according to the existing theoretical frameworks. The discussion has established that digital technologies play a role in the performance of logistics, but not via direct technological impacts, but via establishing organisational capabilities. The combination of RBV, TCE, and DOI allowed understanding the development of capabilities, efficiency

strengthening, and the processes of technology adoption comprehensively. The chapter also identified the essential barriers and enablers that affect the digital transformation in global logistics.

Chapter 06: Conclusion

6.1 Linking Findings to RQs

This study attempted to investigate the impact of digital technologies on the international logistics performance in terms of the development of organisational capabilities. When it comes to the first research question, the study revealed that the primary digital technologies that will influence global logistics are the Internet of Things (IoT), artificial intelligence (AI), blockchain, big data analytics, automation, and transportation management systems. These technologies will facilitate better visibility, real-time tracking, predictive analytics, transparency and automated processes. The results, however, suggest that these technologies do not work alone, but their worth is realised when they are combined into larger digital ecosystems.

The second research question was based on the impact of digital technologies on the performance of international logistics. The results reveal that digital technologies have a role in enhancing the performance of logistics in cost-effectiveness, timeliness, reliability, flexibility, and sustainability. But these improvements are not even area-wide and automatic. The advancement of digital technologies depends on the level of system integration, organisational preparedness, and capacity to utilise data in the most efficient way. The correlation that exists between the adoption of technology and the performance outcomes is therefore indirect and through an organisational factor.

The third research question explored the mediating organisational capabilities on the interaction that occurs between the system of digital technologies and logistics performance. The results indicate that central mediating mechanisms are the visibility, integration, decision-support, and resilience capabilities. These strengths can help a firm to convert the potential of technology into operational effectiveness through coordination, enhanced decision-making, and flexibility. Business organisations that effectively work towards developing these capabilities are in a better position to realise sustained improvement in performance.

The fourth research question was about the hindrances and facilitating factors affecting the uptake of digital technologies. The analysis revealed that organisational factors like

resistance to change, insufficient leadership support and inadequate digital skills are key factors influencing the adoption. Implementation is further limited by technological difficulties, such as interoperability problems and cybersecurity threats. The financial strain and legal intricacies are a major challenge as well, especially to smaller companies. In contrast, high-quality leadership, a focus on strategy, investment into skills development, a strong digital infrastructure, and collaboration between organisations are important facilitators of successful adoption.

6.2 Theoretical and Practical Implications for Logistics and Supply Chain Management

The research has various theoretical implications as it combines the concepts of the Resource-Based View (RBV), Transaction Cost Economics (TCE), and the Diffusion of Innovation (DOI) models. In the RBV perspective, the results strengthen the notion that digital technologies serve as strategic assets which can only create value when they have been integrated into organisational capabilities. As opposed to considering technologies as direct sources of competitive advantage, the study also emphasises that capabilities like visibility, integration, decision-making, and resilience are important mechanisms through which digital technologies promote performance. Regarding a TCE perspective, in the study, the digital technologies were able to lower the transaction costs due to the increase in information sharing, decrease in uncertainty and coordination. Information asymmetry can be addressed with the use of technologies like blockchain and built-in platforms of information to lower monitoring and coordination costs. The results, however, also single out that digital transformation brings about new expenditures in terms of implementation, integration, and governance, implying that efficiency gains are conditional on the organisational and institutional settings.

The DOI framework offers the dynamics of adopting technology. The results show that the perceived benefits, organisational readiness, technological complexity and external environmental considerations play a significant role in adoption decisions. This stresses the need to factor both internal organisational and external institutional conditions in analysing technology diffusion in logistics. Practically, the research is useful to the logistics and supply chain managers. It highlights the need to view digital transformation in a

holistic manner, which incorporates technology, organisational procedures and strategic aims. The development of capabilities, such as data analytics, integration capabilities, change management practices, etc., should be prioritised by managers to achieve the maximum benefits of digital technologies. The results also create the significance of mutual functions and cooperation throughout the supply chain to improve the information exchange and coordination.

6.3 Policy and Managerial Implications

The conclusions of this paper have significant implications for policymakers and managers dealing with international logistics and supply chain management. Organisational managers should also understand that digital transformation is not a technological undertaking but an overall organisational change process on the managerial level. The managers need to concentrate on developing digital capabilities, creating an innovative culture, and integrating digital strategies with business-wide objectives. To make sure that employees have the needed skills to utilise the digital technologies effectively, investment in workforce training and development is necessary. Leadership can be very important in the implementation of digital transformation. The sense of commitment of the leaders is effective in overcoming organisational resistance, particularly in distributing resources and ensuring that technological initiatives and organisational objectives are balanced. Data governance and cybersecurity measures should also be a priority for managers as a way of dealing with risks related to digital technologies. Governments and policymakers have a significant role to play in supporting digital transformation in international logistics, policy-wise. Modifying the resistance to adoption of technology can be decreased by the creation of standardised regulations, interoperable systems and the supportive digital infrastructure. The policymakers should also encourage the partnership between the stakeholders, as well as uphold digital capacity building, especially for small and medium enterprises. To support seamless digital connectivity in global logistics networks, focusing on regulatory disintegration and increasing cross-border collaboration is crucial.

6.4 Limitations of the Study

Although the research has been a valuable contribution towards understanding the role of digital technologies in international logistics, there are a few limitations that can be mentioned. To begin with, the analysis is based only on secondary data, which might restrict the possibility of observing the firm-related practices and current changes. Even though secondary data enables the wide coverage and a cross-contextual analysis, it has the potential of imposing certain limitations in terms of availability and interpretation of data. Second, the qualitative and interpretive aspect of the research implies that the results can be considered context-specific and cannot always be generalised. The variety of international logistics settings, such as technological maturity differences, regulatory settings, and organisational competencies, implies that results might be different across regions and industries. Third, the research is based on the literature, and it lacks empirical validation through the use of primary data. Although this is a synthesis of existing knowledge, further studies involving empirical data would help reap better insight into the extent of organisational practices and better outcomes. Lastly, the fast rate of technological changes implies that the findings can change over time. The relevance of some findings can change in the future due to emerging technologies and evolving regulatory environments.

6.5 Directions for Future Research

In accordance with the results and shortcomings of this research, a number of future research directions are pointed out. First, future research may use an empirical approach, like case studies, surveys, or longitudinal research, to investigate the effects of digital technologies on quantifying the logistics performance in certain organisational settings. This research would be more useful to discern how organisations use digital technologies and create capabilities in practice. Second, the investigation of the use of emerging technologies by international logistics can include new robotics, digital twins, and generative artificial intelligence. The technologies can be used to further revolutionise the logistics operations, though their effects are underutilised. Third, the impact of institutional and regulatory factors on the digital transformation of international logistics might be

investigated in future research. A comparison of research in various locations and jurisdictions would be of great value in understanding the impact of policy frameworks on technology adoption. Fourth, the social and environmental implications of digital transformation in logistics are a topic that could be researched further. Although this paper has outlined the issue of sustainability as an emerging performance aspect, the evaluation of the environmental impacts of digital technologies and their accomplishments towards the attainment of sustainable logistics practices requires further investigation. Lastly, long-term organisational and strategic consequences of digital transformation could be investigated in future research. This will involve studying the development of digital capabilities over a period of time and the role of such capabilities as a contributor to a competitive advantage over time in global logistics.

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