National College of Ireland

The Digital Transformation of Supply Chain Management:

Opportunities and Challenges for International Businesses

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A Dissertation Submitted to National College of Ireland in Partial Fulfilment for the Degree of

Masters of Master of Science in International Business

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ABSTRACT

In today's multi-dimensional world, digital transformation is no longer a desirable goal. Instead, it has become an integral part of supply chain management (SCM) and is being used to revamp international business frameworks. This dissertation is dedicated to the new horizon of SCM concerning the issue dual natural nature of digital transformation in SCM —its opportunities and challenges—particularly I would like to develop a case of how multinational corporations manage along this development path will rely on a systematic literature review where studies published between the years 2019 and 2023 were considered, which will offer the opportunity for a holistic analysis of how the Internet of Things (IoT), cloud computing or artificial intelligence (AI) are played a role to enhance efficiency, responsiveness, and competitiveness for worldwide supply chain management.

These results underline essential features such as boosted transparency, increased efficacy of decision-making, and greater operational efficiency because of automation and data analytics. On the other hand, such advantages are held back by the challenges of high exposure to cyber threats, immense investments in technology, and additional complexity in the digital supply chain system.

The analysis demonstrates that significant digital SCM breakthroughs occur where there is apt strategic planning and in place top-notch digital infrastructure to harness the advantages and reduce the challenges. The findings of this research play a far-reaching role in an academic context, opening up space for further discussions and offering practical advice for business executives and policymakers on the design of international supply chains targeted at digital transformation.

Keywords

Internet of Things, Cloud Computing, Emerging Markets, B2B Online Platforms, Dynamic Capabilities, Opportunities, Challenges, Competitive Advantage, Digital Transformation, Digital Technologies, Supply Chain, Supply Chain Management, International Business, Global Expansion, Business Process Re-Engineering.

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CHAPTER 1: INTRODUCTION

1.1   INTRODUCTION

In the past decade, enterprises worldwide have devoted substantial resources to digital transformations to enhance innovation and efficiency in their operations. Digital technologies and the proliferation of data have facilitated the transition of traditional enterprises into digital entities, leading to a wave of innovation across industries (Rasool et al., 2022). The focus on achieving operational efficiency in the supply chain and improving customer experience has been identified as crucial for organisational success (Digalwar et al., 2020). Labs define supply chain efficiency as the timely and cost-effective delivery of high-quality products to their destinations (Alikhani, Torabi, and Altay, 2021). Achieving operational excellence requires developing and implementing efficient supply chains, with digital technology integration emerging as a crucial aspect of global business operations. Integrating digital technology into supply chain management streamlines processes optimises resource allocation, and enhances efficiency (Chiarini, 2021).

However, a critical examination of the digital revolution in supply chain management was essential. While the benefits of digitisation, such as improved efficiency and innovation, are apparent, exploring potential challenges and obstacles was equally important. Cybersecurity vulnerabilities, data privacy concerns, and over-reliance on technology need thorough investigation (Saeed et al., 2023). Moreover, the dynamic nature of digital environments requires supply chain systems to be flexible and resilient to unforeseen disruptions.

1.2   RESEARCH AIMS AND OBJECTIVES

Similarly, Faruquee, Paulraj, and Irawan back up the opinion that the benefits that digital transformation brings to the supply chain management of a company are unique and very promising, but on the other hand, introduce new complexities that need to be addressed. The core

idea of the supply chain effectiveness is applied critically, especially whether the notion being universal that due delivery must be in timely and cost-effective terms can be universally applied across various industries. For the whole matter to be understood more clearly, the alternative views should also be looked into. Digitalized narratives are extensively around quick workflows and resource allocation despite efficiency if not taken care, would lead to poor resilience and burnout workers according to Moradlou et al.[2021]. The issues of global sourcing differ across industries, organizational sizes and geographical locations, however; with the existence of geopolitical variables in global sourcing, these issues further got complex. A major focal point of digital supply chain transformation is traditional supply chain design which is subject to systemic related issues and an in depth analysis to probe if digital transformation impacts these issues positively or negatively is an example. Integrating digital technology introduces ambiguity and interdependencies, requiring attention to nuances in data interpretation, decision-making procedures, and the interplay of various digital tools and platforms within the supply chain ecosystem (Vaska et al., 2021).

To systematically address the opportunities and challenges inherent in the digital transformation of supply chain management, this research aims to explore the following key objectives and questions:

The objectives are:

1. To critically analyse the advantages and opportunities of digital supply chain management.

2. To critically analyse the challenges enterprises face in adopting and implementing digital transformation in SCM.

3.   To analyse successful organisations' methodologies in managing their supply networks' digital transformation.

Key questions:

1.   What are the primary motivators compelling multinational firms to embrace digital supply chain management?

2.   How can global organisations strategically enhance operational efficiency and agility in supply chain management?

3.   How does digitisation affect the collaboration and coordination of numerous stakeholders in multinational firms' supply chain management?

Research hypothesis:

H1: Digital transformation implementation in supply chain management positively correlates with improvements in operational efficiency, agility, and overall supply chain performance for international businesses.

H2: Industry-specific factors significantly moderate the relationship between digital transformation and supply chain efficiency.

H3: The efficiency of digital transformation in supply chains may lead to trade-offs in terms of resilience, adaptation, and unintended consequences, affecting the overall competitiveness of international businesses.

This study aims to thoroughly investigate the digital transformation of supply chain management within international businesses. Given the substantial resources directed toward digital transformations by enterprises, the supply chain emerges as a pivotal arena for innovation, efficiency enhancement, and strategic adaptation. The study's overarching objectives encompass exploring the advantages and opportunities of advancing digital supply chain management. This

involves an in-depth analysis of success stories and emerging trends to identify critical opportunities for organisations (Frederico et al., 2019).

Additionally, the study seeks to identify and examine challenges and hindrances enterprises face in pursuing digital transformation, covering aspects such as talent acquisition, digital security, technology integration, and change management. Another objective is to understand successful organisations' methodologies in managing their supply networks' digital transformation, drawing insights from case studies and industry practices. By addressing these objectives, the research aims to contribute practical guidance to multinational corporations, informing strategic decision-making and fostering the development of more resilient, efficient, and innovative global supply chains.

1.3   DELIMITATIONS

In this thesis, among one of the sections with limitations, the boundaries the study will respect regarding the thinking lines, time, and resources are set. The research identifies the digital transformation of supply chain management in multinational corporations, notably different industries over the last ten years, as the primary focus. In the course of observation, there is no mention of differences and similarities regarding the organisational size, regional factors, and technical complexities apart from the fact that research does not cover exhaustively detain of specific technologies, regional regulative frameworks, and industry-specific challenges. The geographical scope covers international business activities, considering the factors of local variation and highlights the variations without diminishing the importance of the localised implications. Although there could be some limitations in this present study, we aim to enrich the global debate on the digital SCM aspect of international business.

1.4   RESEARCH METHODOLOGY

This thesis aims to assess the domain of digital transformation in supply chain management through a novel methodology, the systemic literature review. By integrating the recognised protocol proposed by Okoli and Schabram (2010), the research is thoroughly conducted as it carefully encompasses research studies published between 2019 and 2023. A formal selection criterion enhances the study's relevance to digital transformation. The Systematic Review Methodology is implemented as a protocol that aims to systematically get only the relevant and valid information through qualitative and quantitative analyses. The qualitative aspect of the research is analysed through a detailed investigation of the literature content, and the quantitative dimension is assessed through a literature review using Prisma.io software, the best in providing database interactions (Page et al., 2021).

The systematic review outline is in four ways, starting with the Okoli and Schabram protocol and using quantitative and qualitative methods to avoid possible biases (Varsha et al., 2024). The study engages in a holistic approach in the sense that the techniques are simultaneously applied to get a niche in understanding the space for digital transformation correctly. We can evaluate both citation databases by qualitatively examining content and using the Scopus database for a bibliometric review,   including   several   parameters. The study methodology will specify the research method as precise and point to questions that would not be conducted outside the central thesis. The theoretical framework is based on five primary questions that focus on the current thought drivers and frontrunners to digital supply chain management adoption, tactical improvements, collaborative behaviour, successful practices, and consequential implications on profitability, customer loyalty, and market position. The origin of data sources is diverse, and solid databases such as Scopus, Google Scholar, and ABI Inform

Complete are the major ones. The latter was chosen for its comprehensive coverage of scholarly articles on digital transformation in supply chain management. The selection criteria for inclusion in the literature review is a sophisticated methodology, a Boolean search, which uses the keywords that are important to the study that we are studying.

The search covers only academic resources in English, upon the most recent five years, for having an on-time dimension. These collections aim to create strategic and complex information for academic search reference. The methodology comprises a well-thought-out quality appraisal phase, consisting of reviewing the article title, abstract, and whole text, utilising explicit inclusion and exclusion criteria as a basis. Priority for inclusion will be allocated to credibility, academic content, transparency of methodology, database sources, recent publication and the English origin of the journal. On the contrary, the negative enrolled criteria dropped the ambiguous content, non-full-text content, non-English articles, and journals before 2019.

The selection procedure regulates the articles chosen by the research goals and has a high standard of scholarly writing. The data extraction adheres to the PRISMA guidelines, which consists of an initial database search, removing duplicates, filtering the records using an algorithm, manually screening, and selecting records based on set criteria. This systematic method guarantees the transparency and classification of each step, which generally accepts a group of papers into these criteria. The systematic review procedure is demonstrated graphically by the PRISMA chart. This allows the reader to understand precisely the acceptance and exclusion criteria used at each stage (Sarkis-Onofre et al., 2021).

1.5   RESEARCH STRUCTURE

Chapter one analyses the situation with the Digital Enterprise emerging in the last ten years, looking at the new supply chain management (SCM) as the point of origin. It signifies the

significant path between efficiency gains in daily conduct and those presented by digitisation like cybersecurity. The research will emphasise some of the critical issues of digitalisation of supply chain management and contain the main dilemmas to be studied. From the study, the audience would be able to understand the aims and boundaries of research that will be conducted along with the research methods that incorporate the systematic literature review with the defined criteria, as Okoli and Schabram (2021) pointed out. This method is implemented with a blend of qualitative and quantitative approaches to understand the topical issue profoundly. In the second chapter, the theoretical aspect of supply chain effectiveness is investigated, as well as the digital transformation, global sourcing issues, and traditional schemes. It argues that this assumption foregoes the relative universality of supply chain efficiency definitions, implying a difference in priorities when considering the importance of industry-specific factors.

The conversation around digital transformation is critically examined, highlighting connivances and downsides and exploring the biased positive interpretation. Global sourcing challenges would be addressed by contextualising and looking at variations based on the organisational size/sectors or geographic location. Conventional supply chain approaches are redesigned, especially using Capgemini Consulting as a starting point, laying the groundwork for changing old strategies into future strategies. At the end of the chapter, emphasis is placed on the need to unravel the complexity of the digital transformation journey, factoring in the intricacy of digital integration processes. Also, the already complex global setting will serve as a basis for further exploration in later chapters.

Similarly, the methodology in Chapter 3 accompanied the literature review based on Schabram and Okoli's model. Strict criteria make sure of the role played by the chosen papers in the 2019 - 2023 discussion on digitalisation in supply chain management. The approach will utilise a blend

of qualitative and quantitative assessment with the objectives embraced, with the specific research inquiry being the main guiding criteria. Theories postulate that success in the digital transformation process positively correlates to supply chain performance and that external factors such as competitive forces and industry-specific capabilities can be considered during the process. Balancing performance with conflicting goals is a possibility at this level. The schematic diagram represents approaches to systematic review.

PRISMA guidelines for the transparent and carefully conducted data extraction process ensure that 17 reports are selected. It became apparent that in the literature of 2019, digitisation has begun to show greater importance. Chapter 4: Results and Findings section is turned to the research methods, statistical analysis data and expected patterns in the digital transformation of supply chain management. It portrays an ostensible disjunction in the mid-way stage of the research methodologies, which seem to have moved abruptly from the numerical and objective measurements to the more in-depth and multidimensional views of digital transformation. The section puts forward various information, including where the contributors come from, how the thoughts of some writers influenced the products and the keywords that the sector uses. So, we can see companies' acceptance of world collaboration and digital fabric. A flawless literature review has an article categorisation, implications analysis, and distinction-making between digitisation, digitalisation, and digital transformation processes.

In the last part of the article, a frequency chart is featured, highlighting the fundamental keywords moulding a total digitisation of supply chains; these can represent serious advantages to enterprises operating in the present scenario. Within Chapter 5 of the thesis, the implications of digital transformation on supply chain management (SCM) are explored, and trends, opportunities, and challenges are identified. Technologies such as Big Data, data integration, and blockchain are

mentioned in the first section as they emphasise the necessity of businesses to build adaptability in the data warehouses of the future. Following, the chapter discloses the multiple implications of "Industry 4.0" adoption, comprising boosting business performance from renewable energy sources to 'greening' the environment.

Finally, the chapter states vital obstacles, including budget constraints and the priority of a paradigm change, which lend some cues and solutions to this and other processes. Comprehensively, Chapter 5, in its entirety, successfully explains the technical aspect of the relationship between the opportunities and challenges of the SCM framework, which will serve as a source of knowledge for both researchers and management consultants. This summiting chapter 6 elaborates on the worth of digital transformation in multinational companies' supply chain management, focusing on motivators, steps, and negativities.

It underlines that it is an international area of interest and the role and importance of technological advancements. On the bright side, as the boundaries and potential of Industry 4.0 are discovered, challenges such as resource scarcity are highlighted. As the highlighting recommendation, leadership purpose is one of the critical factors of digital transformations because it ought to be informed and backed by a broad set of support systems. It calls for significant digitisation and describes the process as progressive, focusing on modern technology that will open opportunities for progressive investigations and research today. The final paragraph, on the other hand, is the company's roadmap through the spluttering digital spread.

1.6   SUMMARY

Chapter 1 of the dissertation brings up the noteworthy role of digital transformation in changing the world of supply chain management in global business. In the last ten years, expenditure on

digital technologies has shifted from slower to swift innovations driven by continuous improvement procedures that have influenced the running of various enterprises in different industries. The merger of digital solutions posited a crucial moment to inspire the improvement of process efficiency, resource allocation optimisation and superior overall business productivity. Emphasis is put on the normalised and only acceptable way for supply chain operations to function effectively and cost-efficiently to minimise the chances of organisational regression.

Additionally, the chapter explores both the potential and threats possessed by the digital advancement of supply chains. It stresses both the efficiency benefits and the advantages in terms of competitiveness, which are contributed mainly by digital technologies, while simultaneously recognising conditions put in place like cybersecurity risks, data privacy and genuine robust digital infrastructure. Objectives for research are put forward in the form of several core inquiries intended to find out what the main driving factor for digital adoption is, what the ways for operational efficiency enhancement are, and what digitalisation impacts stakeholder collaboration of multinational corporations. This is to ensure a thorough methodology is comprehensively and objectively detailed, particularly the literature, using a systematic review of scholarly works, which aims to provide a holistic and balanced thesis regarding the emerging technologies that are digital transformations towards global supply chain ecosystems.

2   CHAPTER 2: LITERATURE REVIEW

2.1   INTRODUCTION

This chapter focuses on the role of digital transformation as a driving factor in supply chain management practices in cross-border business ventures. The emergence of next-generation technologies paves the way for heightened operational efficiency and decisive competitive dynamics. Systematic analysis of recent research, including industry reports and case studies, is done in the chapter, and it states the applications of technologies such as the Internet of Things (IoT), Artificial Intelligence (AI) and blockchain in the supply chain processes. It evaluates their effectiveness to the end of adding flexibility, conducting better strategic decisions, and implementing green strategies in the global supply chain. The review will try to find and formulate the fundamental notions and the theoretical basis underpinning what digital transformation in supply chains means. It also discusses these technologies' usefulness and difficulties, contributing to a clear vision of the actual academic and practice-based perspectives. Importantly, I have the opportunity to explore the methodologies used in the following chapter, which will also lead to the development of the conclusions and recommendations of this dissertation.

2.2   SUPPLY CHAIN EFFICIENCY: RETHINKING LABS' DEFINITION

In the complex architecture of contemporary logistics networks, the relentless quest for efficiency assumes the roles of a perpetual challenge and an aspirational goal (Moshood et al., 2021; Loonam & O'Regan, 2022; Moghrabi et al., 2023). This search should answer the efficiency issue and how it can be observed, improved, and maintained within different sectors and worlds with different cultures. A unitary perspective of humanised supply chain management's efficiency (Labs' framework opting for timeliness, cost-effectiveness, and quality) has been a de facto standard of discourse. However, with the business environment changing rapidly and global markets

undergoing earth-shaking changes, it is evident that a more sophisticated and flexible theory is needed. According to Moshood et al. (2021), restructuring the current concept of supply chain effectiveness needs to embrace the organic nature of digital transformation and sustainability. The digital era has ushered in unprecedented opportunities for supply chain optimisation. However, it also presents a conundrum: means of applying technical inventions to realise a high level of productivity and sustainable protection of the environment and society.

The infusion of sustainability practices into the digital chain management platform is transforming the conventional operational efficiency metric score by emphasising the indispensability of a balanced score from economic, environmental, and social perspectives (Loonam & O'Regan, 2022; Moghrabi et al., 2023). As supported in the works of Birkel and Müller, this view goes in line with the triple bottom line approach, which considers efficiency as involving costs and quality service assurance, environmental sustainability, and social equality (2021). Such an integrated approach demands novel metrics and performance indicators that align with the complex objectives of advanced supply chains and persuade companies to look at efficiency from a holistic angle, in line with sustainable development principles.

The main idea of the literature review's background is a challenge to the status quo. It is to scratch the surface and realise if the existing paradigms in supply chain management are relevant or not to the fuller perception of supply chain operations (Loonam & O'Regan, 2022). This is where we explore the nuances of present-day supply chains, seeking to uncover the role that the market structure, technological progressions, and regulatory regimes play in efficiency dynamics. Moshood et al. (2021) provide relevant information on industry-specific detail, showing that the "one size fits all" approach did not help manage the complex supply chain. Moreover, the literature

review emphasises that we should not only recognise the interdependency among entities within the supply chains but also accept that there are many diversities.

It is anything but a level playing field when considering the disparities flowing from the poles of small and large enterprises to the contrasts existing across various geographical regions. Hence, the intricacies require a detailed interpretation of efficiency indicators, thus spurring the researchers to think beyond conventional terms' limits and develop new conceptualisations. Here, we are talking about a change of concept that involves being more flexible, and it does not matter if the industry is specific or different; it can change with the times. Loonam and O'Regan's (2022) proposal of embracing industry-defined issues and adapting a more dynamic approach rings a bell for the researchers to rethink and reorganise their approach. Through revitalising the dialogue, which goes beyond rigid definitions and takes the fluidity of supply chain dynamics as the central concern, academics are positioned to lay the foundation for ideational change and a practical approach (Moghrabi et al., 2023).

This involves concluding what we already know, discerning the points of disagreement, figuring out areas that are left unanswered, and asking questions that call for further research. In essence, a literature review is a driver for intellectual exploration, provoking researchers to move away from the power of one to embrace the intricate ways of supply chain efficiency. Through the process of criticism of the accepted norms and the development of the more inclusive paradigms based not only on the widely noticed methods but also the established accepted paradigms, researchers can operate most effectively and advanced on the detailed scenery of the supply-chain systems. The final work not only deals with a simple paraphrase but also with opening new perspectives, ending up joining solid communities and then getting the ball rolling in a world that never stops shifting.

An example of this would be the new technologies such as AI, IoT and block-chain are the eye glasses that help one see the productivity of supply chains (Javaid et al., 2022; Wang et al., 2020; Gurtu & Johny, 2019). These new technologies have a great potential to become a paradigm shift by which the future of the supply chains will be formed due to several positive outcomes such as improved transparency, traceability and responsiveness. For example, keeping track of the original product in an immutable blockchain record, to which a product belongs, will help decrease the products with fraud and ensure a responsible source (Wang et al., 2020; Gurtu & Johny, 2019).

Supply chain efficiency can also be ensured using AI and IoT to manage supply chain patterns and meet demand by reducing waste and resource allocation. (Javaid et al., 2022) Nevertheless, applying these technologies required a detailed debrief on what has been believed to be productive, shifting the focus from cost cutting and operation rate to resilience, adaptability and moral aspects. Transformation of industrial systems is a great chance to reform the process of supply chains re-adjustment and turning it into the discovery mechanism of how to develop and support the long-term supply chain efficiency in accordance to today's requirements to deal not only with economic profit but also with continuity of sustainability and ethics of supply chain processes. The involvement of these viewpoints in the supply chain management process will result in the combination of experts and practitioners where a more sustainable, sturdy, reasonable and global supply chain ecosystem will be developed (Jraisat et al., 2021).

2.3 DIGITAL TRANSFORMATION IN SUPPLY CHAINS: SCRUTINIZING STREAMLINING NARRATIVES

Come to the 21st century when global trade is everywhere and supply chain management only becomes more important with the development of digital technologies, know-how (Moghrabi et al., 2023), as well as tools and techniques (Gurtu & Johny, 2019), and analytics (Abideen et al.,

2021). The digitalization of Supply Chain Management (SCM) is demonstrating that it is all due to the development of that technological tools such as the Internet of Things (IoT), Artificial intelligence (AI), Blockchain, and Big Data Analytics have become tools to improve SCM. Balancing the negative sides of digital transformation alongside supply chain efficiency, such as costs, time and product quality is a challenging task. The conclusion of (Labs, 2014) study respective of supply chain efficiency accomplishes an expansion (optimisation) of operations. On the other side, it makes the traditional logistics more efficient and helps add some sustainability and resilience previously lacking (Moghrabi et al., 2023; Gurtu & Johny, 2019; Abideen et al., 2021). According to the article by Gurtu and Johny (2019), blockchain technology on supply chains not only increases transparency but also traceability, hence fair sourcing of commodities is ensured while counterfeit products are fought against. Through that, not only do sustainability become a main concern but ethical production too. Abideen et al. (2021) provide the evidence of digitalisation modelling that reduces the wastes in the supplies thus enhancing the efficiency and flow of productions.

Digital transformation within supply chain management improves operational efficiency and drives performance metrics (Moghrabi et al., 2023; Gurtu & Johny, 2019; Abideen et al., 2021). The digital revolution, propelled by Industry 4.0, which encompasses AI, the Internet of Things (IoT), and blockchain, cannot be denied as the pivotal cause of the transformation of the supply chain strategies, giving rise to a new quality of performance and visibility (). Therefore, findings reveal that digital technologies are transformative, as they underscore the role of Industry 4.0 in enhancing efficiency and competitiveness. However, the streamlining storyline and the advent of digital transformation challenged conventional views on supply chain efficiency and resiliency (Ivanov et al., 2018; Baz and Ruel, 2021; Mangla et al., 2022).

The research by Ivanov, Dolgui, and Sokolov (2018) reveals that supply chain risk analytics improve efficiency and are potentially risky due to vulnerabilities along interconnected supply networks. This dual characteristic of process enhancement yet enhanced vulnerability calls for a balancing act approach to digital transformation, in which the chase after operational streamlining is complemented by resilience-building and robustness-enhancing strategies during COVID-19, as noted by Baz and Ruel (2021). It says apart the different factors of the digitally-adjusted supply chains and gives us more insight. Such as the blockchain technology for tracing tea supply chain discussed by Mangla et al (2022), produce powerful example of how technologies may be useful in achieving transparency, sustainability, and improved welfare in the industry (Yang et al., 2021). On another note, various challenges are facing integration of such technologies, including the technical complexity of the operations, stakeholders' stability as well as alignment, as indicated by Gurtu and Johny (2019), and Wang et al. (2020). Digital transformation that interacts with real-world supply chain management shows that digital transformation is a multi-type of phenomenon which go beyond just operational efficiency but also comprises of big issues of sustainability, transparency and most importantly collaboration among stakeholders. Moreover, the digital transition of the supply chains is inseparable with the sustainability agenda and where application of blockchain and AI is not only to make the networks run smoothly but also they can assist in driving the adoption of sustainable and responsible supply chain practices (Bag and Pretorius, 2020; Moghrabi et al., 2023).

Bag and Pretorius (2020) provide a framework that fills the gap between Industry 4.0, sustainable manufacturing, and circular economy, emphasising the synergies between digital transformation and sustainability targets. This crossroad provides evidence that digital technologies can be the key contributing factors in the transformation towards a more responsible and sustainable supply

chain structure which suits environmental stewardship and social equity as the highest guidelines (Javaid et al., 2022; Ramadan et al., 2022). The strategic impact related to the digital to resign from the international business aspects is tremendous, making a review of supply chains and practices necessary. With the evolution of digital supply chains, international businesses will have difficulty dealing with platform integration, cybersecurity, and cross-border data flows (Loonam and O'Regan, 2022; Johnson and Haug, 2021).

Loonam and O'Regan (2022) stress the strategic aspects of global value chains and digital platforms, suggesting that digital transformation includes technological adoption, organisational agility, and strategic alignment (Ng et al., 2022; Miroudot, 2020). In this context, the thesis title "The Digital Transformation of Supply Chain Management: "Digital Innovations in SCM: Opportunities and Challenges for International Businesses" dwells on this transformation era when international businesses take the leads to discover the benefits and overcome the challenges brought by digital innovations in SCM (Xu et al., 2021; Miroudot, 2020). Overall, the issue of digital transformation in supply chains, with its display of the apparent advantages of smoother processes and increased effectiveness, shows a professional field characterised by complexities and challenges.

2.4   GLOBAL SOURCING AND AMBIGUITY: CONTEXTUALIZING CHALLENGES

In the era of globalisation, the strategic importance of external sourcing for the efficiency of entire supply chain processes has never been greater, as there are complex issues not limited to technical and operational aspects. Johnson and Haug (2021) demonstrated the necessity of amended supply chain management strategies due to the recent trade disturbances, which underscores the fact that agility and adaptability must be prioritised while uncertainty is present. In addition, the shift to Industry 4.0 technologies by Akbari et al. (2023), which are transformational, also requires the

business to manage the challenges of digital transformation in diverse structural and regulatory environments.

The aforementioned reveals the universality of companies' challenges in global sourcing activities (Braglia & Castellano, 2021; Min Joo, 2020). Universal challenges, like supply chain disruptions, do not create equal effects because they affect everything differently. For example, manufacturing industries whose output is highly dependent on intricate processes are greatly affected by issues related to service delivery and customer satisfaction (Gunasekaran et al., 2021). This shows the urgency of holistic approaches that adapt to each business sector's varied operational dynamics. With regard to the role of the organizational size in global procurement problems, the study by Min and Joo (2020) offers the best option. Small-scale businesses, a direct victim of the scarcity of resources on one hand and on the other hand dwarfing in comparison with the bargaining power of the biggest players on the market, these are the ones that have to go through the daunting task of surpassing the international market difficulties. Through this asymmetry, the dynamics of trading reinforce the urgency for equity in trade by the introduction of a fair-trade practice that will approximate the unequalities in the international system for all market players (Wu et al., 2021). Nevertheless, it underlies the importance of creating particular frameworks, hence enhancing small firms to move to the next level of market competition.

Nevertheless, the adjacent fashion of geographical location becomes a crucial element that makes global sourcing difficult. It is important not to understate the relevance of geometry/territorialization, which will be called international trade laws and regulations as well as the cultural identity in other places (Lei et al., 2021). In this way, they emulate wave-like behavior that is subjective and fluctuated thus imposing adaptive solutions (Liu et al., 2022). In the same manner, technical tensions and trade disputes raise the complexity of global sourcing, a factor that

indicates clear the significance of geopolitical risk management as one of the vital components of a good supply chain strategy (Yan et al., 2020).

Asgari et al. (2019) highlight using risk identification technologies and predicative systems will make it convenient to spot where and how danger emerge and prevent it which in turn will foster adaptive and resilient business (Sohail et al., 2019). Miroudot (2020) states this is a complex situation thisworldver positivethe Various trade provisions, frameworks, cultural phenomena might need theirpecific approaches rather than a general approach for effective indicator process. Not only will the supply chain management have strategic consequences and impose the necessity to refocus the supply chain than usual, through the limits of common domains (Wu et al., 2021). Responsiveness which is now a critical competitive force is an outcome of a feedback model where market dynamics, regulatory reforms and operational risks affect how organizations run their business as a result.

As a result, this concern is an element that needs to be well designed in a manner that includes the risk assessment, market analysis, and predictive modelling as the fundamental pillars of global sourcing strategies. It helps with identifying inconsistencies, and devoting due attention to underlying imperfections while providing a paradigm for precise relationships and strategies of enhanced stability and efficiency (Lei et al., 2021). Employing future-oriented management tools together with comprehensive market research and scenario planning are useful elements that help businesses in predicting any changes in the global sourcing realm. So, they can proactively modify their strategies by implementing an anticipative strategy (Asgari et al., 2019). Strategic resilience can foster an organization to fill in the gaps of the unregulated terrain of international marketplaces.

It has become a prerequisite by responding to the promptness of unexpected threats that determines the ultimate success (Liu et al., 2022).

Another positive effect oftechnological innovations is that they provide answers to the international supply of problem solving (Gunasekaran et al., 2021). Digital technology containing blockchain, AI, and enhanced analytics does work as a front-liner in putting transparency, efficiency, and collaboration into international supply chain. The appointment of a digitalized supply chain further reduces risks originating from a reliable supplier, as well as compliance with contracts in line with the blockchain technology which is based on unalterable records representing contracts (Braglia & Castellano, 2021). AI and machine learning algorithms strengthen predictive abilities so firms can calculate scenarios and find an effective way to manage disruptions in the supply chain with higher accuracy. Similarly, IoT devices enable real-time tracking and monitoring of goods so they are always good and delivered on time (Min & Joo, 2020).

By overcoming these technologies, organisations can cease traditional limitations and open new sources for optimisation and value creation in their global sourcing processes. These innovations conquer and set the base for even more integrated, resilient, and flexible supply chain systems (Lei et al., 2021). Examples, including the immigration problem, make the double-edged nature of digital transformation even more evident in terms of global outsourcing. For example, the incorporation of blockchain in the tea supply chain that Mangla et al. (2022) focused on demonstrates that digital technologies can be a tool for transparency and ethical sourcing. However, deploying such technologies is faced with challenges, such as the enormous investments required for the infrastructure and the expertise on the technical side (Lassnig et al., 2021).

2.5   REEVALUATING CONVENTIONAL APPROACHES: CAPGEMINI'S INSIGHTS

Wang et al. (2020) identify that it is imperative to go beyond the apparent immediate effect of departmental separation, which is being used to justify the complexity that is associated with supply chain inefficiencies (Min et al., 2019). In addition, Gurtu and Chibhu (2019) note that the paradigm shift is not just technical change but a completely different outlook and means of operating the supply chain. According to the experiment by Wang et al. (2020), digitalization is a part of chain interconnection and transparency which is to some extent an opposite with the fragmental and unclear supply chain traditionally used supply (Gupta & John, 2019).

A key drawback of traditional supply chain management methods (like reported by Wang, et al. in 2020), would be the impairment of real-time visibility of the entire systems, overall arrangement, communication and information sharing therein. Such a hierarchical approach entails the creation of a great number silos which in turn often become constraints to efficient operations. This is because the organization is not agile enough to respond effectively to the dynamics of the changing market settings. The absence of standard frameworks is the challenge point as the dynamic nature which may be from macroeconomic changes or bad weather is something that calls for a faster response. Disaster management leaders such as the team of Min et al. (2019) suggest such unpredictability as a challenge. Despite there being numerous intricacies and hard structures linked to these standardised supply chains, one can find that an alley where the digital transformation can mitigate these problems is a very real possibility (Gurtu and Johny, 2019). Examples of new technologies and analytics include artificial intelligence and advanced analytics can help with real-time visibility and the decision-making process (Wang et al., 2020).

Furthermore, blockchain technology is embraced as a secure and decentralised method for information exchange, facilitating seamless transfer of information between supply chain

participants, which diminishes the negative consequences of organisational segregation, as Gurtu and Johny (2019) noted. However, digital transformation involves specific challenges and issues, new opportunities, and access to a wide range of information. Advanced technologies need organisational readiness, investment in infrastructure, and awareness of the new values of team collaboration and information sharing.

Additionally, the path towards an evolutionary supply chain involves steering the complex relationships between technological possibilities and institutional inertia (Wang et al., 2020). As traditional banking shifts to digital, these challenges cannot be underestimated: resistance to change, skill gaps, and the digital integration of legacy systems (Gurtu & Johny, 2019). Nonetheless, they should be seen as obstacles to overcome if organisations want to leverage the power of digital transformation. A process underpinned by elements of strategy and methodology is much more than just the use of the new technology; instead, it is a cultural shift towards agility, transparency, and continuous learning (Min et al., 2019).

Therefore, organisations can advance to the highest levels of efficiency and resilience while meeting customer satisfaction needs as never before, a huge step forward from conventional supply chain models. By implementing digital transformation as a strategic enabling tool, organisations will move beyond the old, outdated supply chain models and create a new, agile, resilient, and optimised network ecosystem. Technology is at the core of achieving this vision, but a holistic approach must incorporate other aspects like organisational culture, process redistribution, and strategic alignment.

2.6   UNPACKING COMPLEXITY: BEYOND DESCRIPTIONS

Against the current era of supply chain management (SCM), digital transformation brings a paradigm change that affects not only the technologies but all other aspects. Such changes, enabled

by the arrival of Industry 4.0 and the advances to Industry 5.0, embrace the interplay between technological, strategic, and organisational changes (Ghobakhloo et al., 2022). The exigency of such complexity is vividly demonstrated through the lens of digital twins and a learning framework.

Abideen et al. (2021) witness the proceedings of digital twins, interconnected with enforced learning, changing logistics into a dynamic simulation of the supply chain processes and their optimisation. With this progress, efficiency and management are dramatically affected. Moreover, according to Ivanov, Dolgui, and Sokolov (2022), the application of cloud supply chain solutions reflects the principle of "Supply Chain-as-a-Service," which draws a connection between digital platforms and supply chain operations. In this structure, the movement of an SCM system toward a more responsive, agile, and integrated model is revealed as an embodiment of the discussed thesis on the influence of digital transformation on businesses in the global community (McLaughlin, 2020).

The findings of Akbari et al. (2023) on the effects of Industry 4.0 in Vietnam are worth noting in terms of how digital transformation is redesigning the entire landscape of the SCM and the importance of adaptation and innovation in navigating the new digital age. In the same way, Gurtu and Johny (2019) give a real example of how blockchain technology is applied in supply chains by focusing on using digital technologies to improve traceability and transparency. However, integrating technology and collaboration is also a requirement of the stakeholders. According to Carnovale and Yeniyurt, cybersecurity and data privacy will be the major concerns in digital SCM (2021).

Saeed et al. (2023), who studied digital transformation and cybersecurity risks in supply chain resilience, give an example of suitable strategies that should be built to secure digital

infrastructures and sensitive information. It is also important to note that this will substantially contribute to the thesis since it will clarify that technology innovation should be balanced with security alongside digital transformation. In addition, the digital readiness of organisations, as investigated by Lassnig et al. (2021), is a significant factor in the remote success of digital transformation initiatives in SCM. This readiness includes not only technological infrastructure but also the adoration of organisational culture, strategic alignment, and workforce capabilities to utilise digital technologies successfully (Javaid et al., 2022)

2.7   RESEARCH GAPS

Despite the considerable progress in digitising supply chain management, many areas still demand more exploration, mostly an in-depth analysis of emerging technology features in the dynamic operational environments of international businesses. According to Munna, Shaikh, and Kazi, the glaring omission here is the lack of careful evaluation of the long-term sustainability implications of digital conversion initiatives (2023).

Studies have analysed the immediate efficiency gains and operational improvements in detail, resulting in supply chains being increasingly digitally transformed. Still, empirical research on environmental and social sustainability outcomes is lacking over time. Such a lack of oversight hinders the ability of policymakers and business leaders to act logically according to universal long-term sustainability objectives (Aamer et al., 2022). Moreover, the existing literature tends to treat digital technologies as a single entity, placing too much emphasis on why they are, or are not, creating new forms of value and competitive advantage and what new risks and ethical considerations they introduce. According to Brinker and Haasis, the literature has been limited to exploring strategies that address the geopolitical and regulatory challenges in supply chain management posed by digital transformation for international businesses (2022).

The dissolution of traditional borders, the creation of a more integrated global economy, and the increase of regulatory requirements, sovereignty of data, and cybersecurity threats that come in different forms across different jurisdictions are the kinds of complex business landscapes that companies have to deal with. Though what companies do to handle the challenges, shift their strategies, and exploit digital transformation for geopolitical advantage is not researched widely, there are also research efforts looking at the importance of the consequent cultural competence in the successful adoption of the digital supply chain, given the different levels of digital readiness and IT infrastructure in the various regions (Seyedghorban et al., 2019).

2.8   CHAPTER SUMMARY

The chapter reveals findings from diverse studies, practical knowledge, and empirical evidence, which creates a discourse that deepens the understanding of the radical change digital technologies cause to global supply chains. Recent technologies, including AI and blockchain, have introduced a new paradigm where resilience has become vital. Nonetheless, this transformation does not come without its complications, thus necessitating a classic SCM system approach, technical implications, and agility in reacting to the evolving global market dynamics. The framework of this chapter corresponds to the dual character of digital transformation, which has the potential to create supply chain efficiencies never seen before while also creating the need to strategically look forward and be agile in finding solutions.

3 CHAPTER 3: METHODOLOGY

3.1 INTRODUCTION

The study covers the literature related to digital transformation in supply chain management through a systematic literature review protocol, which is the methodology used by Okoli and Schabram in 2020; from 2019 to 2023, a constant flow of research papers was discovered. The inclusion criteria for our analysis were stringent so that only documents directly relevant to digital transformation were considered. The systematic review methodology used in this research facilitated the careful collection of meaningful and reliable information about digital transformation. By following a well-defined and very carefully designed procedure, the systematic review was expected to minimise systematic errors or biases. It constituted a concerted attempt at searching for, evaluating and summarising all relevant studies that used a particular methodology. Therefore, the qualitative and quantitative approaches used in this study were complementary, re-enforcing each other to create a holistic and contextual picture of the digital transformation landscape of supply chain management.

3.2 RESEARCH OBJECTIVES, QUESTION AND HYPOTHESIS

The objectives are:

1. To critically analyse the advantages and opportunities of digital supply chain management.

2. To critically analyse challenges faced by enterprises in their pursuit of digital transformation.

3. To analyse successful organisations' methodologies in managing their supply networks' digital transformation.

Key questions:

1. What are the primary motivators compelling multinational firms to embrace digital supply chain management?

2. How can global organisations strategically enhance operational efficiency and agility in supply chain management?

3. How does digitisation affect the collaboration and coordination of numerous stakeholders in multinational firms' supply chain management?

Research hypothesis:

H1: Digital transformation implementation in supply chain management positively correlates with improvements in operational efficiency, agility, and overall supply chain performance for international businesses.

H2: Industry-specific factors significantly moderate the relationship between digital transformation and supply chain efficiency.

H3: The efficiency of digital transformation in supply chains may lead to trade-offs in terms of resilience, adaptation, and unintended consequences, affecting the overall competitiveness of international businesses.

3.3   RESEARCH PHILOSOPHY AND APPROACH

The research philosophy and approach that will reinforce the research will be practical, and where possible, elements from both positivism and interpretivism will be combined. Giving the character of the work, such as the digital transformation of supply chain management from a practical standpoint, enables us to have an emphatic approach to solving the current theoretical and practical problems. The philosophy appeals to the truth that comprehending digital transformation is about objective analysis and subjective understanding, giving concerned people the room to see things

differently and realise that narratives are played mainly by the different stories narrated by various stakeholders (Khatri, 2020).

Figure 1: Saunders' Research Onion
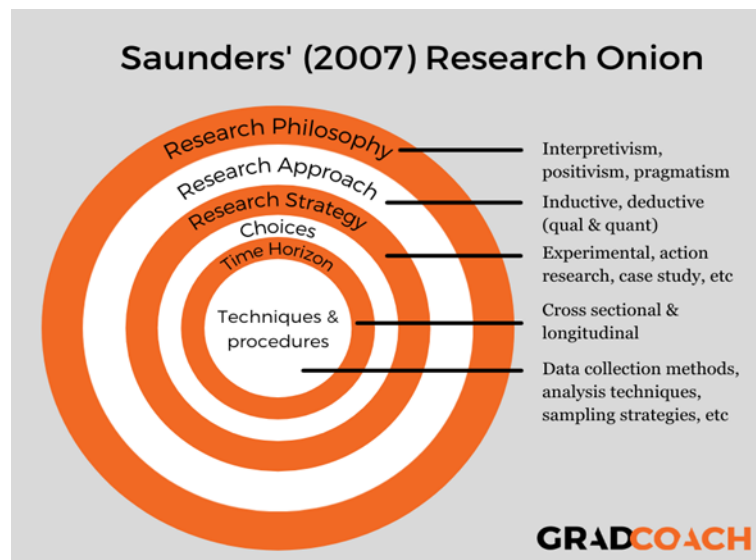
Source: (Phair & Warren, 2021)

As stipulated by Phair and Warren, the approach is indeed inductive in that it is meant to result in insights and theories that stem from the analysis of relevant materials collected (2021). In-depth scrutiny of these previous works between 2019 and 2023 using the data highlights the long-term and short-term patterns, themes and narratives of the digital transformation in supply chain management, granting a more detailed explanation of this area. This study will use the collection review strategy, which employs a systematic literature review as the general tool. This would carefully extract and analyse data from extant sources, becoming the primary tool. The approach is advantageous when the focus is on events with thorough research, for instance, on digital

transformation within supply networks, which have been the subject of waves of research in the past by scholars (Hanelt et al., 2020).

The given research is also qualitative, and the mono-method is a Systematic literature review. In opting for the single reliable method, the opportunity for a narrow and prolonged study of the already available literature has been created so that the conducted research agrees with the questions posed by the project (Mardiana, 2020).

The study is cross-sectional, with a data analysis and literature review conducted on published studies during the period chosen (2019-2023). Thus, by applying this approach, a reader gets a view of cutting–edge findings and progress in implementing digital transformation strategies in supply chain management that will be up-to-date and fresh in point.

3.4   RATIONALE FOR CHOOSING SYSTEMATIC LITERATURE REVIEW

3.4.1   ALIGNMENT WITH RESEARCH OBJECTIVES

The fundamental purpose of this dissertation is to discover the possibilities of digitalisation in supply chain management from the perspective of international businesses and companies. Systematic literature review (SLR) is just the correct type of research in this case as it helps synthesise all the existing research by documentation and analysis. So, it enables one to grasp both the details of opportunities and threats of digital transformation. This technique supplies a well-formulated framework for the procurement of different scholarly papers to widen the scope of research, thereby analysing various perspectives and findings in the area of interest (Sarkis-Onofre et al., 2021).

3.4.2 REPLICABLE AND RIGOROUS FRAMEWORK

An SLR has a rigorous and explicit method, as these qualities are pertinent to subjectivity and repeatability in research. The SLR tries to avoid any bias by repeating a set protocol. This protocol consequently raises certainty of its own result because things can be tested. Specifically, this kind of detailing is a must in case of advanced subjects such as digital supply chains, with the technological and strategic components of them to grow ever more complex and change perpetually (Krüger et al. 2019).

3.4.3 COMPREHENSIVE DATA COLLECTION AND ANALYSIS

Statistical Language Resource (SLR), as mentioned by Krüger et al. (2019), follows the mechanic approach, making sure that all fiscal data is analysed all through and systematically. Hence, building up an effective research following various search strategies (like using proper databases and relevant search words), assigning an exclusion and inclusion criteria, and screening insightful trends and themes is what lays the foundation for conducting a comprehensive literature review. The broad trend of data capturing and processing plays a particular role in assessing the influence of digital revolution on business world organizations performances.

3.4.4 SUITABILITY FOR EVOLVING FIELDS

Digital transformation is one rapidly developing sphere that can boast of being an extensive and continuously developing branch of science. An SLR is a treasure capable of representing all the exciting twists and turns of such a complex undertaking, thus highlighting the current research and pointing to places where more research is needed. This is true for the research objective of investigating the existing practices and predicting what will happen in supply chain management in the future and the concerned challenges.

3.4.5 FACILITATION OF MULTIFACETED INSIGHTS

The present dissertation will be significantly advantaged by the use of the SLR (systematic literature review) technique, which would be the very basis for the integration of different research on digital transformation that covers issues such as technological innovations and strategic as well as organisational change (Krüger et al., 2019). The SLR journal is getting as a result of the integration of information from different sources. Thus, it provides a comprehensive coverage of the influence of digital transformation on various levels of the supply chain management function in various industries and regions.

3.4.6 DISCOVERING NEW INSIGHTS AND PASSING ON PRACTICAL EXPERIENCES TO THE FUTURE GENERATIONS.

Ultimately, an SLR provides an anchored interface for both theoretical and practical contributions. It makes a cognate framework possible that creates a reasonable basis for bridging fragment bits of knowledge into a single theory of digital transformation. According to Cabrera, it marks the way for workable strategies and warning of the perils; therefore, it dramatically impacts business planning for the companies looking forward to the digital transition (2023). These helpings constitute the most important factors, which the beneficiaries should adequately contain, and digital technologies should be used to promote their market positions on a global scale.

3.5 SCHEMATICS

3.5.1 IDENTIFYING RESEARCH

A methodical review methodology has been employed to fulfil the aims delineated in this thesis. In initiating my inquiry, the initial phase involved defining a problem and reframing an objective into a well-defined, organised, and unequivocal question, adhering to the prescribed protocol. Of particular focus within this study is exploring the digital transformation of supply chain

management and the opportunities and challenges for international businesses. A series of inquiries were undertaken to address this, encompassing the research questions.

3.6   DATA SOURCES

Outline of databases that are to be used in the field of studies referring to digital transformation and its influence on modern international business sphere should meet two criteria: to cover a broad scope of issues and make use of reliable sources, such as articles and surveys. Among the databases selected, ABI Inform Complete: A lot of works by scholars and summarized research results are wide available on ProQuest and Google Scholar, as they are a well-known sources which can be trustworthy. In this case certain data fields will provide one to thousands of various resources of knowledge, namely peer-reviewed journals, dissertations, and theses, that help in deep study of a subject (Gusenbauer & Haddaway, 2020).

Table 1: Sysematic Literature Review Data Sources

Database	Description	Rationale
Scopus	Scopus, a reputable database for the past 19 years, is renowned for its vast collection, comprising 39,647 titles, of which approximately 35,000 are peer-reviewed journals. It is a comprehensive resource for scholarly publications.	Scopus is chosen for its long-standing reputation and extensive coverage of peer-reviewed journals. The database provides a robust foundation for in-depth research on the opportunities and challenges associated with the digital transformation of supply chain management.

Google Scholar	Google Scholar is a widely used academic search engine that indexes scholarly articles, theses, books, conference papers, and patents. It provides a broad and interdisciplinary view of research across various fields.	Google Scholar is included to ensure a broad search, allowing access to a wide range of scholarly resources. Its interdisciplinary nature is beneficial for obtaining a holistic understanding of the impact of digital transformation on supply chain management.
ABI Inform Complete	ABI Inform Complete, available through ProQuest, is a comprehensive database encompassing many surveys. Its content repository exceeds 6 billion digital pages, making it one of the largest dissertation collections.	This database is particularly valuable for its extensive coverage of various surveys, which aligns with the need to explore diverse perspectives and insights related to the digital transformation of supply chain management.

The selected databases, systematically construct the foundational block of this SLR, deploying strategic and integrative approach to achieve academic rigor and diversity of the input resource pool.

3.7   SELECTION CRITERIA

To achieve a truly all-inclusive study of the digital transformation of supply chains and its consequences at the international stage, we have deployed a complex Boolean search technique that helps us in uniting disparate but relevant search terms of the topic. Critical literature search included both journals and articles published within the last four years until 2020 in English, thus providing a current and pertinent field of reference. Within the context of search engine optimization, keyword selection can sometimes present a decision process that requires deep analysis. It may become clearer by studying other relevant papers and posts in the same domain or with the similar objective.

Summarizing our search strategy is the very table 1 demonstrating a thoughtful arrangement of context terms, IT and transformation, intelligently used AND and OR methods and logical operators. Such search string ("("Digital transformation" OR "Industry 4.0" OR "Industry 4.0" OR "Smart Factory" OR "Digitalization") AND ("transformation" OR "management" OR "change" OR "strategy")"), with a wide net involving keywords and abstracts, provides for a detailed and easily navigated perusal of the study materials (Gusenbauer & Haddaway, 2020).

Table 2: Keywords and Search Terms

Digital Transformation in Supply Chain Management	""	Business Impact and Global Considerations
"Digital Transformation"	AND	"Supply Chain Management"
"Industry 4.0"	AND	"International business"
"Smart Factory"	AND	"Global business"
"Digitalization"	AND	"opportunities"

"Change"	AND	"challenges"
"Transformation"	AND	"Business models"

For our study, we used Scopus digital libraries as the largest database of citations and abstracts on these topics containing peer-reviewed bibliographies and highly qualified Internet sources. We did it like and procured the relevant data after applying smart tools in the follow-ups, examination, and graph creation.

Systematic Review's Overview guided by Scrupos Search is presented in the Table 2. Search terms and filters used here are comprehended in its criteria. The search is limited (probing) of only main keywords and indexed keywords. Inter alia, it will infer for us to use a range of resources for an exhaustive research of literature with focus on quality and relevance of a given supply chain management evolving in the digital age and the international organizations affected by the phenomenon..

Table 3: Scopus systematic review process

Institute for Scientific Information - SCOPUS	
Criteria	**Filters**
Restriction	Topic (Title, Abstract, Keywords)
Language	English
Years	2019-2023
Source Material	Academic Journals, Research Reports, Books, Conference Proceedings, Industrial Magazines and Websites

3.8   EXTRACTION OF DATA

3.8.1   QUALITY APPRAISAL

The initial range was not a target for a vast amount of papers from various disciplines without any fundamental limitations initially. Nonetheless, for the purposes of this work that makes an intensive research concerning the influence of digital transformation on industrial companies, we are reducing all coherent search results to the selected measurable benchmarks. Systematic exercises in full texts of journal papers and an extensive review of abstracts and titles were the main factors to detect quality of articles. The next thing we did was to perfectly set up explicit inclusion and exclusion criteria to make navigating the selection procedure easier (Shaffril et al., 2020).

Inclusion Criteria:

Table 4: Inclusion Criteria

Criteria	Inclusion	Reason
Relevance	Articles directly addressing digital transformation in supply chain management.	Ensures direct alignment with the research focus and objectives.
Publication Type	Academic content	Academic papers are prioritised for their depth and rigour in contributing to a high-quality literature review.

Methodology.	Articles with a transparent and well-defined research methodology.	Ensures the credibility and rigour of the research methodology.
Database	Articles published in reputable and recognised journals or from reputable sources.	Guarantees the reliability and authority of the information.
Year of publication.	Articles published between 2019 and 2023.	Ensures the inclusion of recent and up-to-date literature.
Language	Articles written in the English language.	Facilitates universal understanding and accessibility of content (Van Dinter, TekiNerdoğan and Çatal, 2021).

Exclusion Criteria:

Table 5: Exclusion Criteria

Criteria	Exclusion	Reason
Document Type	Editorial, keynote, opinion, tutorial, workshop, summary report, poster, unpublished articles, master's theses, and books	These document types lack the rigour of peer-reviewed scrutiny, ensuring the inclusion of scholarly content.
Availability of Full-text	Unavailability of full-text	Full-text availability is crucial for comprehensive analysis and understanding; hence, articles without full-text access are excluded.

Language	Non-English articles	English is the official and universal language, ensuring accessibility and understanding for a diverse audience.
Publication Year	Before 2019 and future publications	Focusing on articles from 2012 to the present ensures relevance to contemporary discussions on digitalisation and the digital supply chain.
Publication Type	Non-academic content (e.g., blogs, news articles)	Academic papers are prioritised for their depth and rigour in contributing to a high-quality literature review (Mengist et al., 2020).

3.8.2 ASSESSMENT OF QUALITY

This second phase of this research process is dedicated to thoroughly analysing the articles that survived the first filtering stage. The three Steps are meticulous stages. Title and abstract evaluation are the first step of rigorous evaluation, followed by an intense review of the text articles' overall quality. The first stage of this evaluative enterprise includes the title and abstract screening procedure. In this phase, the remaining articles are critically analysed based on predefined criteria established in the previous stage that comprised exclusion and inclusion limits. Titles and abstracts may serve as rapid writing tools in searching for the essence of articles with a precise selection among the contents that reflect closely on topics while dismissing those out of high tangent.
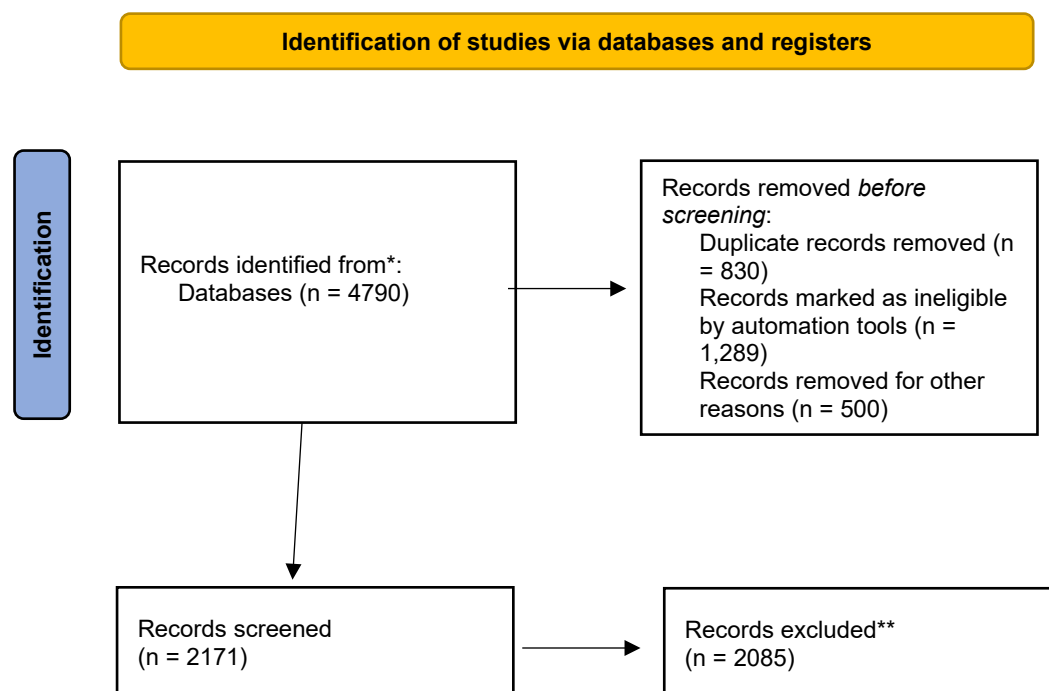
The author passes the stage of title and abstract screening, after which he goes through a detailed review of full-text information about retained articles. Thus, there is an answer to whether the chosen papers managed to meet quality standards and content requirements that would fit the

research goals determined in the thesis. Thus, the critical review of the whole reading helps understand not only that what is discussed in selected articles has adequately developed content but also effectively develops towards obtaining such realistic goals as were presented by the thesis.

3.8.3   DATA EXTRACTION

The systematic literature review for the thesis on "The Digital Transformation of Supply Chain Management: The "Opportunities and Challenges for International Business" article was developed according to PRISMA guidelines. Initially, a broad search of multiple platforms produced an extensive 4790 records. Eight hundred thirty duplicate records were removed before the screening, and 1,289 records were flagged as ineligible by automation tools; another 500 were excluded for reasons that were not specified. Two thousand one hundred seventy-one records were evaluated to evaluate whether they aligned with the research focus in a subsequent screening phase. Two thousand one hundred records were excluded from this pool during the screening phase based on predetermined criteria.

Figure 2: Prisma Flow Diagram

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Screening
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Reports sought for retrieval
(n = 86)

Reports not retrieved
(n = 16)

Reports assessed for eligibility
(n = 70)

Reports excluded:
    Reason 1 (2 = Written in
    foreign language)
    Reason 2 (5 = Incomplete
    Access to Full Text)
    Reason 3 (3 = Irrelevance to
    Digital Transformation)
    Reason 4 (5 = Mismatched
    Objectives)

```
Included
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Studies included in review and
studies
(n = 55)
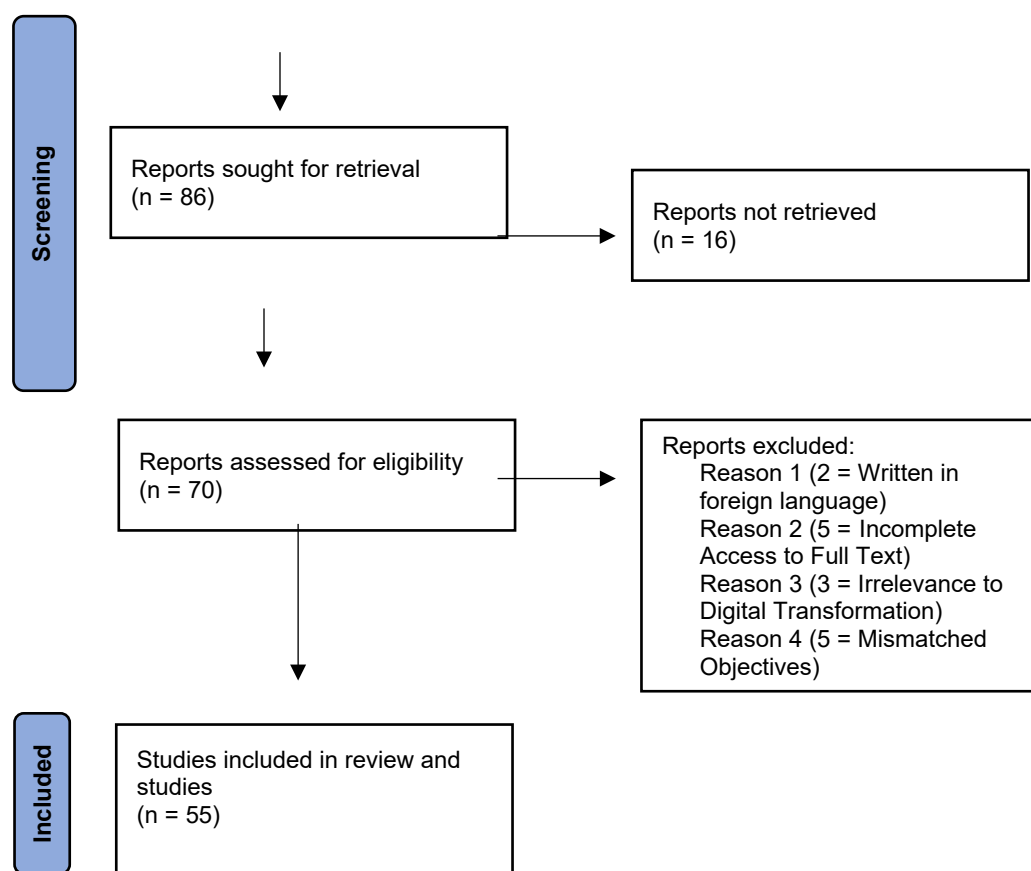
The exclusion criteria were diverse, encompassing factors such as foreign language, incomplete

access to full text, irrelevance to digital transformation, and mismatched objectives. A subset of

71 reports was identified for retrieval from the remaining records. Subsequently, 55 reports

underwent eligibility assessment, excluding specific reports based on criteria such as language,

access limitations, relevance, and objective alignment. Ultimately, 23 studies met the eligibility

criteria and were included in the systematic review. Seventeen reports were generated from these

studies, providing a comprehensive view of the selected literature. In 2019 – 2023, the number of

papers on digital transformation significantly increased yearly. Significantly, since 2019, a pronounced surge has been observed, marked by an annual increase of over 20 articles. This distribution underscores a twofold ascent since 2020, signalling the escalating significance of the digital transformation arena.

3.9   SUMMARY

Chapter three of this dissertation zeroes in on the methodological choices undertaken to delineate digital transformation in supply chain management, particularly regarding a systematic literature review as proposed by Okoli and Schabram. Ranging research distribution in the years 2019 - 2023, only the precise and related to digital transformation studies are the ones of consideration. This advanced approach ensures that high-quality data is gathered, which has limited chances of distortions and errors due to the objectivity of the methodology. Therefore, it helps generate platforms for a broad and comprehensive perception of how digital transformation affects the management of supply chains. The chapter unambiguously elucidates the research purpose, with the objectives of this study including a critical assessment of how digital transformation affects supply chain management, the pros and cons of digitisation, and the extent to which it can improve the agility and efficiency of operations. However, it is essential to consider the threats aligned digitisation might pose to stakeholder collaboration and coordination.

Meanwhile, the chapter explains the research philosophy and methodology; this happens through an amalgamation of positivist and interpretivist philosophies to attain practical and complete worthwhile knowledge. This 2-pronged technique gives a deep look into the quantitative and qualitative data type, thus adding more dimensions to the study. The literature search for a systemic review is done carefully, adhering to the standard research tier with clear selection, eligibility, and analysis criteria. Such an approach, however, enables the integration of a wide range of different

views on this subject, which, in one way or another, results in a profound and exciting understanding of the ramifications of digitalisation for the operations of international supply chains. Although a complex review procedure, with meticulous data source screening and a robust method of quality evaluation, is considered, the outcome of this study will be solidly backed and considerably boost the efforts related to both academic and practical realms.

4   CHAPTER 4: RESULTS AND FINDINGS

4.1   INTRODUCTION

We use a systematic literature review to address the digitisation of the supply chain management field for international businesses. We aimed at collating, processing and presenting exciting and relevant views and opinions from different intellectual sources such as books, journal articles, research papers, academic theses, and official reports, whose overall focus is how digital technologies are revolutionising global supply chain management. The systematic approach utilised in our research toolkit has ensured a comprehensive survey of what is going on now and what is to come in terms of digital strategies' efficiency, as well as what they never saw coming for businesses as they integrate these technologies into their supply chains.

This section was designed in ascending order with the findings from the data extraction, a detailed report on the various sectors, and ending with a summary of the literature review of digital transformation bound to supply chain operations. Another focal area was the placement of digital transformation research regarding geography and sectors. In addition, this area considers digital transformation strategies and how they are often aligned with business objectives. Therefore, aside from the advantages, the different dimensions and complexities are highlighted to prove that digital transformation in supply chain management processes is multi-dimensional.

4.2   RESEARCH METHODS

Research methodologies from the reviewed literature also seem dualistic as they rely on quantitative and qualitative paradigms. Studies such as the qualitative analysis of the transformation aspects of the digital age by Gülçin Büyüközkan and Fethullah Göçer. Yanqub and Alsabban, (2023). In their qualitative literature review, they zoom into the complexity of the digital

supply chain by dividing the effects of some critical digital technologies, such as blockchain, IoT, Big Data automation, and robotics. 70% of the surveyed articles utilise qualitative methods, 20% use a mixed-method approach, and only 10percent employ quantitative approaches (Akbari et al., 2023). The amalgamation of qualitative and quantitative perspectives within the literature enriches the comprehension of the multifaceted implications of digital transformation in supply chains.

4.3 DATA EXTRACTION FINDINGS

In delineating the geographical origins of the 55 articles under scrutiny, a captivating tapestry of diversity unfolds, weaving insights from 21 distinct countries. European contributors are standing prominently on this global stage and command a significant share of 34% of this scholarly ensemble. In tandem, the intellectual landscape is enriched by the resonant voices of Asian countries, contributing a substantial 29%. The remaining 37% elegantly converges into a mosaic featuring North/South America (15%), a hint of Oceania (1%), and a compelling 21% from the harmonious collaboration of mixed-country affiliations. This rich geographic symphony paints a vivid picture of international collaboration and underscores the cosmopolitan essence of the collective research endeavour. Certainly! Here is how you can group the in-text citations in Harvard style for the articles relevant to global contributions to digital supply chain management (SCM) research (Aamer, Sahara, & Al-Awlaqi, 2022; Abideen et al., 2021; Akbari et al., 2023; Bag & Pretorius, 2020; Baz & Ruel, 2021; Birkel & Müller, 2021; Brinker & Haasis, 2022; Faruquee, Paulraj, & Irawan, 2021; Frederico et al., 2019; Ghobakhloo et al., 2022; Gurtu & Johny, 2019; Hanelt et al., 2020; Ivanov, Dolgui, & Sokolov, 2018; Ivanov, Dolgui, & Sokolov, 2022; Javaid et al., 2022; Johnson & Haug, 2021; Jraisat et al., 2021; Kim, 2021; Krüger et al., 2019; Kumar, Singh, & Dwivedi, 2020).) :

Figure 3: Global Contribution to Digital SCM Research
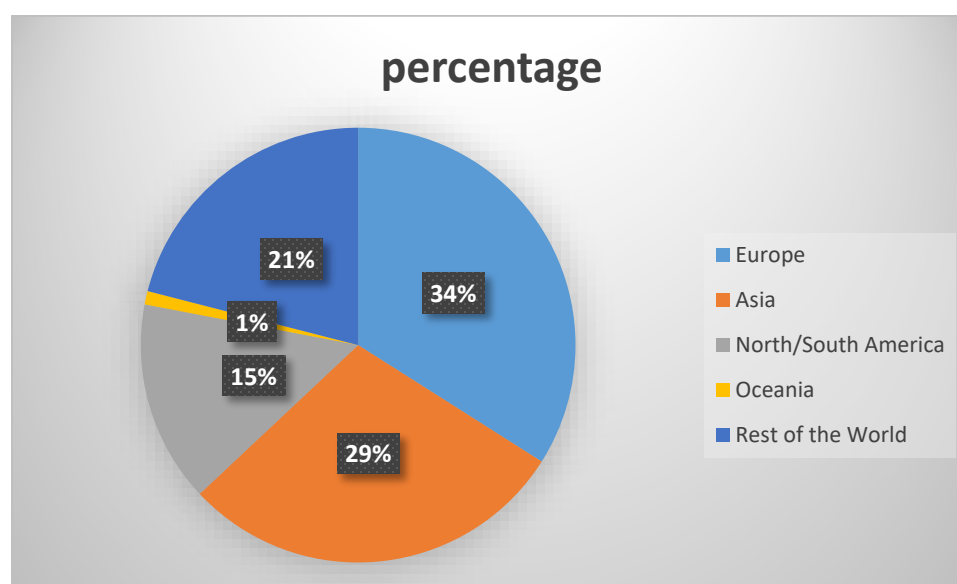
In explaining the topography of impactful authors in this field, the most prominent contributors were carefully selected according to citation numbers outlined in Table 4. This ranking – based on the Scopus database and carefully taking into account numerous metrics, including the total number of citations 2 It is particularly worth mentioning landmark articles strongly oriented on the issue of digital change strategy and its actionable insights for practitioners, reflective of such scholarly works of (Ferreira, Fernandes and Ferreira, 2019) (Appio et al., 2021) In addition, a fine-grained analysis of articles posted in various journals was carried out, revealing MIS Quarterly Executive as the flagship journal within this field. This journal is also noted for being prominent in practice-based research in information systems by presenting its findings to readers in an easily understood manner.

4.4   EXPLORED SECTORS

In the digital transformation landscape within supply chain management, my research delved into countless cutting-edge keywords, terminologies, and topics that shape the technological tapestry of this transformative journey for large corporations. Blockchain, a decentralised ledger

technology, took centre stage, ensuring transparent and traceable transactions through cryptographic security and the execution of self-executing contracts known as smart contracts (Gurtu & Johny, 2019; Mangla et al., 2022; Wang et al., 2020). With the help of more sophisticated machine learning algorithms, predictive analytics became a crucial instrument for corporations, enabling accurate demand forecast prediction maintenance and complex modelling data (Mangla et al., 2022).

The fusion of robotics process automation (RPA) optimises operations in warehouses and uses robotic arms and drones to boost effectiveness. For example, edge computing is the key that makes it possible to carry out real-time data processing and thus shorten lead times when making decisions. Digital twins and virtual doubles of physical assets open up monitoring and simulation to a new level where they easily integrate with the Internet of Things IoT. Cognitive computing driven by artificial intelligence creates systems mimicking human cognition, using natural language processing and decision support (Ivanov, Dolgui, & Sokolov, 2018; Ivanov, Dolgui, & Sokolov, 2022; Javaid et al., 2022; Seyedghorban et al., 2019; Xu, Vogel-Heuser, & Wang, 2021).

Augmented and virtual reality redefined warehouse optimisation, training environments, and remote maintenance. Cloud-based digital supply chain platforms with robust interoperability features enable data from multiple sources to be seamlessly integrated (Ivanov, Dolgui, and Sokolov, 2022, p. 102676). The analysis does not stop at dark data; uncovering the hidden information and seeing network security and resilience strategy as risk management is also paramount in case of disruptions. This research shines a light on the intricate yet revolutionary terrain of digital supply chain management for large companies, delving into the technological subtleties that drive them to participate in Industry 4.0.

Table 6: Most emerged keywords and Technologies from the research

Keywords/Topics	Technologies
Blockchain	Predictive Analytics
Predictive Maintenance	Industry 4.0
Smart Contracts	Network Security
Internet of Things (IoT)	Dark Data
Digital Twins	GPS and Geospatial Tracking
Artificial Intelligence	Supply Chain Visibility
Cyber-Physical Systems	Augmented Reality (AR) and Virtual Reality (VR)
RFID (Radio-Frequency IDentification)	Machine Learning Algorithms
Cloud-based Platforms	Robotics Process Automation (RPA)

Figure 4: Frequency of Occurrence of the Keywords
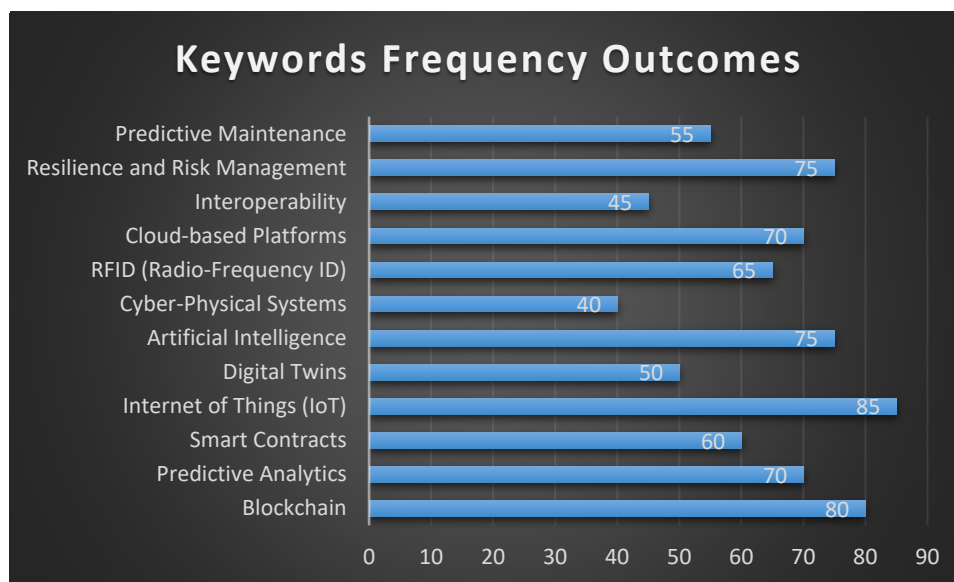
4.5   LITERATURE REVIEW ON DIGITAL TRANSFORMATION IN SCM

Table 7: Digital Supply Chain Management Terms and Referenced Articles

Terminology	Abbreviation	Article Citations
Digital Supply Chain	DSC	Abideen et al. (2021). Logistics, 5(4), p. 84 [1]; Ivanov et al. (2022) Transportation Research Part E, 160, p. 102676 [2]; Johnson and Haug (2021) Journal of Global Operations and Strategic Sourcing, 14(4), pp. 701–722 [3]; Kumar et al. (2020) Journal of Cleaner Production, 275, p. 124063 [4]; Lassnig et al. (2021) Journal of Manufacturing Technology Management, 33(9), pp. 1–18 [5]; Preindl et al. (2020) Supply Chain Forum, 21(1), pp. 26–34 [6]; Ramadan et al. (2022) Sustainability, 14(10), p. 5841 [7]; Verhoef et al. (2021) Journal of Business Research, 122, pp. 889–901 [8]; Yang et al. (2021) Technological Forecasting and Social Change, 169, p. 120795 [9]; Yaqub and Alsabban (2023) Sustainability, 15(11), p. 8553 [10].
Internet of Things	IoT	Javaid et al. (2022). Internet of Things and Cyber-Physical Systems, 2, pp. 49–62 [11]; Nambisan et al. (2019) Research Policy, 48(8), p. 103773 [12]; Saabye et al. (2022) International Journal of Operations & Production Management, 42(13), pp. 25–53 [13]; Shashi et al. (2020) Industrial Marketing Management, 90, pp. 324–345 [14]; Xu et al. (2021) Journal of Manufacturing Systems, 61, pp. 530–535 [15].

Big Data	-	Kumar et al. (2020). Journal of Cleaner Production, 275, p. 124063 [4]; Ng et al. (2022) Sustainability, 14(7), p. 4327 [16]; Wang et al. (2020) Automation in Construction, 111, p. 103063 [17].
Radio Frequency Identification	RFID	Abideen et al. (2021) Logistics, 5(4), p. 84 [1].
Sensor Technology	-	Abideen et al. (2021). Logistics, 5(4), p. 84 [1].
Automation	-	Johnson & Haug (2021). Journal of Global Operations and Strategic Sourcing, 14(4), pp. 701–722 [3].
Robotics	-	Abideen et al. (2021). Logistics, 5(4), p. 84 [1].
Artificial Intelligence	-	Baz & Ruel (2021). International Journal of Production Economics, 233, p. 107972 [18].
Industry 4.0	-	Baz & Ruel (2021). International Journal of Production Economics, 233, p. 107972 [18]; Javaid et al. (2022) Internet of Things and Cyber-Physical Systems, 2, pp. 49–62 [11].
Cloud Computing	-	Ivanov et al. (2022). Transportation Research Part E, 160, p. 102676 [2].
Drones	-	Gurtu and Johny (2019). International Journal of Physical Distribution & Logistics Management, 49(9), pp. 881–900 [19].
Blockchain	-	Gurtu and Johny (2019). International Journal of Physical Distribution & Logistics Management, 49(9), pp. 881–900 [19]; Wang et al. (2020) Automation in Construction, 111, p. 103063 [17].

Sustainable Manufacturing	-	Bag and Pretorius (2020). The International Journal of Organizational Analysis, 30(4), pp. 864–898 [20]; Machado et al. (2019) International Journal of Production Research, 58(5), pp. 1462–1484 [21].
Circular Economy	-	Bag and Pretorius (2020). The International Journal of Organizational Analysis, 30(4), pp. 864–898 [20].
Supply Chain Risk Management	-	Baz & Ruel (2021). International Journal of Production Economics, 233, p. 107972 [18].
Sustainable Development	-	Ghobakhloo et al. (2022). Sustainable Production and Consumption, 33, pp. 716–737 [22].
Industry 5.0	-	Ghobakhloo et al. (2022) Sustainable Production and Consumption, 33, pp. 716–737 [22]; Mourtzis et al. (2022) Energies, 15(17), p. 6276 [23].
Flexible Manufacturing System (FMS)	-	Javaid et al. (2022). Internet of Things and Cyber-Physical Systems, 2, pp. 49–62 [11].
External Environment	-	Kim (2021) Turkish Journal of Computer and Mathematics Education (TURCOMAT), 12(10), pp. 987–995 [24].
Business Models	-	Marcon et al. (2022). Technological Forecasting and Social Change, 185, p. 122078 [25].
Society 5.0	-	Mourtzis et al. (2022) Energies, 15(17), p. 6276 [23].
Sustainable Operations	-	Kumar et al. (2020). Journal of Cleaner Production, 275, p. 124063 [4].
Ethical Operations	-	Kumar et al. (2020). Journal of Cleaner Production, 275, p. 124063 [4].

Learning-to-Learn Capability	-	Saabye et al. (2022). International Journal of Operations & Production Management, 42(13), pp. 25–53 [13].
Global Supply Chain Management	-	Johnson & Haug (2021). Journal of Global Operations and Strategic Sourcing, 14(4), pp. 701–722 [3].
Global Value Chains	-	Loonam & O'Regan (2022). Strategic Change, 31(1), pp. 161–177 [26].
Sustainable Supply Chain	-	Mangla et al. (2022). Business Strategy and the Environment, 31(8), pp. 3693–3716 [27]; Moshood et al. (2021) Cleaner Engineering and Technology, 4, p. 100144 [28].
Precautionary Principle	-	Mangla et al. (2022). Business Strategy and the Environment, 31(8), pp. 3693–3716 [27].
Definitions of Supply Chain Management	-	Min et al. (2019). Journal of Business Logistics, 40(1), pp. 44–55 [29].
Implications of COVID-19	-	Miroudot (2020) Journal of International Business Policy, 3(4), pp. 430–442 [30].
Post-Pandemic Era	-	Ramakrishna (2022) Handbook of Research on Supply Chain Resiliency, Efficiency, and Visibility in the Post-Pandemic Era [31].
Industry 4.0 and Internal Organizational Forces	-	Ramadan et al. (2022). Sustainability, 14(10), p. 5841 [7].

Strategic Objectives	-	Ramadan et al. (2022). Sustainability, 14(10), p. 5841 [7].
Business Resilience	-	Saeed et al. (2023). Sensors, 23(15), p. 6666 [32].
Digital Transformation	-	Verhoef et al. (2021) Journal of Business Research, 122, pp. 889–901 [8].
Supply Chain Traceability	-	Wang et al. (2020). Automation in Construction, 111, p. 103063 [17].

4.6   DIGITAL TRANSFORMATION

Digital transformation has become very popular recently and is a significant paradigm shift that companies catalysed. To fully comprehend this concept, it is essential to outline the differences between digitisation, digitalisation and digital transformation. Following are defined these three terms. Digitisation refers to transforming from analogue into digital representations, encoding information using binary language (0 and 1) (Hanelt et al., 2020). On the other hand, digitalisation uses digitised data and tools to automate handling data and optimise processes, which are also associated with computerisation. Digital transformation is a frequently used but rather dynamic term that implies the radical changes in consumer behaviours and new things hitting contemporary business models and organisations (Hanelt et al., 2020; Nambisan et al., 2019; Seyedghorban et al., 2019; Verhoef et al., 2021).

According to the literature, "digital transformation" is a term widely used, even though sometimes inappropriately, just because there are no formal definitions. Authors (Frederico et al., 2019;

Hanelt et al., 2020; Nambisan et al., 2019; Saeed et al., 2023; Seyedghorban et al., 2019), tried to define it, with the first strict definition in it was related initially to digitisation at that time. However, its modern sense involves new consumer behaviour that affects present business models and organisational frameworks. This transformative process involves technological, organisational and social aspects that require strategic alignment leadership and a culture shift within organisations. Here is the combined in-text citation for the references discussing the modern sense of digital transformation, its effects on consumer behaviour, business models, organisational frameworks, and the requisite strategic and cultural shifts (Hanelt et al., 2020; Nambisan et al., 2019; Saeed et al., 2023; Seyedghorban et al., 2019; Verhoef et al., 2021; Loonam & O'Regan, 2022; Johnson & Haug, 2021; Ivanov et al., 2022; Vaska et al., 2021). Its effects come out in every aspect of customer interaction, business processes and general business structures; therefore, an organisation that wants to succeed should be ready to adapt its dynamics holistically with the rapid growth of technology and changing market positions.

4.7   EMERGING PATTERNS IN THE DIGITAL TRANSFORMATION OF SCM

The pivotal indicators of these trends are encapsulated in the frequency chart of keywords (Chart 1) and the comprehensive exploration of sectors (Table 6) presented herein. These elements serve as valuable compasses, elucidating the research trajectory in this domain. Notably, the identified keywords, including Internet of Things (IoT), RFID sensor technology, Big Data, Cloud computing, Blockchain technology, robotics, and artificial intelligence, recurrently surface in the abstracts of the analysed articles. The prominence of these keywords signifies their pivotal role as major trends steering the digitalisation of supply chains, warranting a meticulous examination(Javaid et al., 2022; Gurtu & Johny, 2019; Ivanov et al., 2022; Mangla et al., 2022; Saeed et al., 2023; Wang et al., 2020). Furthermore, the consistent co-occurrence of these

keywords is not unexpected; instead, it underscores the intricate interdependencies among these technologies contributing to the holistic digitisation of supply chains. Although the Digital Supply Chain (DSC) is still nascent, its potential value remains untapped. The ongoing technological revolution propels supply chains into a phase of rapid evolution and complete restructuring.

As outlined in the introductory chapter, the transition from a traditional/mixed logistics model to an entirely digital paradigm involves substituting physical stores with data centres, replacing tangible boxes with bits, and seeing bandwidth take the role of physical trucks. The infusion of digitalisation into the fabric of the supply chain holds the promise of substantial benefits, paving the way for differentiation and competitive advantage. This chapter aims to scrutinise the amalgamation of these benefits and explore certain limitations inherent in this groundbreaking approach. It comprehensively overviews the digital supply chain as a cohesive and fully operational system (Abideen et al., 2021).

4.8   SUMMARY

Chapter 4 is dedicated to the findings and results of a comprehensive literature review. The literature review outlines a few main pieces of evidence related to the digitisation of supply chain management for international companies. In the development of the chapter, the authors attempt to fit in diverse sources of information, like books, articles, academic journals, research papers, and official reports, to portray how digital technology is redefining global supply chain management. It illustrates how digital strategies are, in fact, highly efficient and carry unexpected influences as they are cross-bred with business supply chains maturing. This gives the research a geographic spread and an alignment of digital strategies with business objectives. The paper points out that digital transformation in supply chains has changed multi-dimensional aspects, which

shows the interaction between technical and business processes as the organisation becomes more productive and its strategic abilities improve.

The research approach adopted by the literature on global supply chains is in line with both qualitative and quantitative research traditions, emphasising the qualitative analysis to probe deeper into digital supply chains. The chapter exemplifies the geographical diversity and intellectual contributions of many countries, including those by European and Asian researchers, stating their essential role in the history of the disease. Moreover, it delves into industry-wide implementations of digital innovations, namely blockchain, IoT and AI, where the undeniable efficiency gains and innovative effects on supply chain structures are graphically portrayed. Proper scrutinisation of keywords and technologies found in the literature identifies new tendencies and themes, providing a complete picture of here and now and the future direction of digital transformation in supply chain management. In this chapter, we draw a picture of the digital supply chain innovations space, propose an approach to critical assessment and explore the possibilities and challenges they bring to international business.

5   CHAPTER 5: DISCUSSION

5.1   INTRODUCTION

This chapter explains the implications of digital supply chain management (SCM) on international business outcomes. However, the world markets have been witnessing rapid change, led by technological advances and new customer requirements, and the pressure on the supply chains has kept increasing. This chapter discusses the critical factors, showing their impact in driving multinational companies to equip themselves with digital supply chain management tools, which facilitate excellent operational efficiency, a good customer relationship, and credible global branding. The objective of the following is to present the goal of the analysis, which will result in the well-founded recognition of the schemes through which digital SCM will boost international competitors' advantages with supporting data and theoretical models.

5.2   OBJECTIVE 1: ADVANTAGES AND OPPORTUNITIES OF COMPANIES EMBRACING DIGITAL SUPPLY CHAIN MANAGEMENT

5.2.1   INTRODUCTION

Digital supply chain management (DSCM) has since become the new tale for companies seeking competitive operational efficiencies and strong customer relationship building. Notwithstanding the myriad benefits of digital concepts over traditional supply chains in running businesses through competitive global markets, digital supply chains are a distinct concept that offers complexities both to managers and other field actors.

5.2.2   DISCUSSION

Facilitation of corporate growth and diversification

Industry 4.0 proves instrumental in driving corporate growth and facilitating diversification in the competitive global marketplace. Businesses are urged to keep pace with technological evolution, and I 4.0, with its advanced technologies such as robotics, AI, and Big Data, enables rapid internationalisation (Kim, 2021).

The integration of these technologies enhances business process automation and market needs analysis, providing a foundation for identifying and realising growth opportunities. Moreover, introducing new technologies under Industry 4.0 fosters knowledge acquisition and skills development within organisations, contributing to enhanced competitiveness. The adoption of Industry 4.0 is not merely a technological upgrade but a catalyst for diversifying business-oriented operations, supporting portfolio management and formulating innovative business strategies (Saabye et al., 2022).

Improved quality of governance

Governance quality, a critical aspect of organisational success, undergoes significant improvement with integrating Industry 4.0 technologies, particularly blockchain. Whether in hierarchical or hybrid organisations, governance is characterised by transparency, accountability, fairness, and independence. Through its verifiable transactions and smart contracts, blockchain addresses agency problems and reduces associated costs. The immutability of data in blockchain ensures a trustworthy and transparent system, impacting the balance of power between directors, managers, and shareholders. Beyond blockchain, big data tools enhance governance efficiency by providing timely and cost-effective data for decision-making processes (Ghobakhloo et al., 2022).

Enhancement of quality of social embeddedness

As shown by Mangla et al., the importance of relationships is a significant concern of the theory of relational exchange concerning getting a competitive edge (2022). As part of Industry 4.0 technology, blockchain significantly improves communication between key stakeholders in supply chain networks. Blockchain clarifies inter-organizational commitments to long-term relationships and performance because visibility, transparency, and equity help establish trust among organisations (Seyedghorban et al., 2019; Yang et al., 2021). In particular, blockchain allows enterprises to view their internal business processes and records more clearly to improve collaboration. In addition to blockchain, extensive data analysis facilitates partnership development by better understanding stakeholder needs, preferences and actions over time. Trust in competence can be further boosted through industry 4.0 technologies by enabling real-time decision-making processes with its partners. Industry 4.0 technologies have brought about transparency, fairness, and adaptability, resulting in lasting relationships and sustainability (Ghobakhloo et al., 2022).

Driver and enabler of reshoring

The concept of reshoring, referring to the repatriation of operations from foreign countries, is becoming popular in Industry 4.0. While Industries have myriad reasons to review their offshoring decisions, the development of Industries 4.0 technologies gives them quite convincing reasons to do so. Industry 4.0 will bring many innovations changing the way the process happens and become much more of a competitive trait to bring production home. The application of such innovations allows for faster and more convenient procurement with risks of disruptions in supply chain minimized, besides better coordination among the processes of production (Machado et al., 2019). As it's not only about cost saving, it seeks the implementation of smooth logistical support to help

the business' operations closer home.. On the hand, Industry 4.0 gives you an opportunity to choose reshore as it allows you in avoiding labour-intensive, downsizing-based, cost minimisation and flexible manufacturing (Machado et al., 2019).

Support and delivery of mass customisation

Mass customisation which is supported by Industry 4.0 can be proved as the primary engine of the next wave of manufacturing revolution. It will enable consistency through the negotiated range by utilizing shared products and processes, which is a move towards personalized manufacturing departure from large-scale production. The Internet of Things (IoT) makes it possible that a number of methods can be employed whereby, companies can use the interconnected things to observe customers' behaviours accurately for the transformation in business processes. (Kumar et al., 2020). This information is further refined through Big Data analytics, which provides insights into a company's customer preferences and behaviours. Netflix uses data to improve its customer relations better than its competitors, such as in the case of Netflix, which utilises big data for superior CRM. I 4.0 adoption also guarantees personalised products through Big Data analytics and a deep understanding of shifting consumer needs and wants, leading to long-term customer loyalty (Cantrell, 2001). However, this requires a deeper focus on discerning these changing preferences for effective communication and targeted operational processes (Van Es, 2022).

Complement or to Lean Six Sigma

The marriage of Lean Six Sigma (LSS) methodologies with Industry 4.0 creates a powerful synergy for enhancing business process performance. LSS, known for its focus on reducing process variance and waste, seamlessly integrates with the connectivity and real-time capabilities of Industry 4.0. Businesses embracing Lean methods are more likely to adopt Industry 4.0

technologies because LSS tools depend heavily on real-time data for defect detection and correction (Abideen et al., 2021). This integration has several advantages, such as predicting process failures, improving product and service quality, and significant cost reductions. Advanced analytics from Industry 4.0 accelerates data collection, analysis, and deployment, making production processes more flexible. The combination of LSS and Industry 4.0 improves process efficiency and provides a world-class quality framework that enables organisations to stay ahead of the curve (Javaid et al., 2022).

Driver of innovation performance

Sector 4.0's adoption now serves as a substantial catalyst for innovation in technology, economy and trade. The strategic use of industry 4.0 technologies - including extensive data analytics - brings business model innovations in digital ecosystems. With these technologies, it is possible to reconceptualise business models, improve competitiveness and structure meaningfully dynamic work (Ramadan et al., 2022). Various studies have shown that incorporating Industry 4.0 into supply chains improves innovation performance. Without business model innovations in digital ecosystems and product and process innovations, Industry 4.0 technologies are not viable if you hope your business stays competitive in the long run. The strategic reframing of business models and the flexibility afforded by Industry 4.0 positions organisations to navigate dynamic market conditions, fostering a culture of innovation.

5.4.2.1.Facilitation of environmental and social sustainability

Industry 4.0 (I 4.0) technologies are emerging as vital tools to achieve environmental targets and social equity. With the triple bottom line approach that values economic, social and environmental benefits, blockchain and I 4.0 technology are essential (Ng et al., 2022). Through blockchain

technology, products can be tracked accurately, lowering rework and recall levels and reducing resource wastage and greenhouse gas emissions. In addition, blockchain-based peer-to-peer power systems contribute to the decentralised energy network, which reduces inefficiencies caused by long-distance power transfers (Bag & Pretorius, 2020). Big data analytics (BDA) is coupled with artificial intelligence (AI), the firm's circular economy capability. It can help achieve product design, manufacturing, and marketing with a lower carbon footprint.

This can reduce the carbon footprint on pathways of product flow to a certain extent and ensure that supply chains are open and healthy, eventually fostering ethical sourcing paths (Mourtzis et al., 2022).

5.3   OBJECTIVE 2: KEY CHALLENGES IN THE ADOPTION AND IMPLEMENTATION OF DIGITAL TRANSFORMATION IN SCM

5.3.1   INTRODUCTION

This section focuses on the enormous obstacles holding foundries face during digital SMCM system deployment. It is a thorough analysis that explores obstacles such as integration challenges, fighting against change, and the effect of expensive advanced technologies. At this moment, these discussions respond to the topic in the research question that represents the problems that the adoption of practical digital SCM faces. The ability to be aware of the issue is indispensable in the cause of familiarising the factors that stand in the way of the success of digital transformation, which is one of the most crucial facts in creating solid strategies for overcoming stumbling blocks. This insight is a part of the dissertation project that will serve to give an objective point of view

on Digital SCM and explain how it can be helpful while simultaneously revealing the problems that can be associated with it.

5.3.2   DISCUSSION

The pervasive adoption of Fourth Industrial Revolution technologies (Industry 4.0 or I 4.0) in SCM has become a pivotal factor in enhancing organisational competitiveness. However, the implementation of these transformative technologies is not without challenges, as various scholars have elucidated. This section explores the critical challenges associated with the effective adoption and implementation of Industry 4.0 and offers insights into potential remedies.

Table 8: Addressing Digital Transformation Barriers in Global Supply Chains

	Challenges	Elucidation	Source	Solution
1.	Resource Constraints	• Scarce financial resources limit the ability of international businesses to invest in supply chain digital transformation due to high implementation costs. • A lack of technical expertise and skilled personnel hinders the successful adoption of digital technologies in	(Yang, Fu and Zhang, 2021)	• Financial Constraints: Limited financial resources hinder the acquisition of advanced technologies and the implementation of comprehensive digital solutions in the supply chain. • Expertise Shortage: Insufficient internal expertise and talent for managing and implementing digital transformation projects can impede international

		supply chain management for international companies.		businesses from effectively adopting and leveraging digital technologies in supply chain management.
2.	Digital Readiness	• International businesses may struggle with digital transformation in supply chain management due to employees lacking digital skills and awareness. The workforce may be unfamiliar with new technologies, hindering the implementation of digital solutions • Some international businesses face challenges seamlessly integrating diverse digital technologies into their existing supply	(Lassnig et al., 2021)	• Invest in comprehensive training programs to enhance digital literacy among employees. Provide workshops, online courses, and resources to familiarise the workforce with digital tools • Conduct a thorough assessment of the current supply chain infrastructure and identify areas where digital technologies can be integrated. Implement a phased approach to adoption, ensuring compatibility and addressing integration challenges gradually.

		chain processes. Incompatibility issues and resistance to change can impede the smooth adoption of digital solutions.		
3.	ICT capability	• International businesses often struggle to adopt digital transformation in supply chain management due to inadequate Information and Communication Technology (ICT) infrastructure. This limitation can hinder the seamless integration of digital tools and technologies • Small- and medium-sized international businesses may face resource constraints,	(Preindl, Νικολόπουλος and Litsiou, 2020)	• Invest in upgrading ICT infrastructure, implementing high-speed internet and robust digital technologies, and ensuring widespread access. Collaborate with local governments and technology providers to establish a supportive technological environment. • Develop strategic partnerships, seek government incentives or grants, and explore scalable solutions that align with the available resources. Implement a phased approach, prioritising critical areas for ICT

		including financial, technical, and human resources, which impede the effective implementation of digital transformation in the supply chain.		implementation based on the business's specific needs and capabilities.
4.	Change paradigm	• Industry 4.0 requires a shift in the fundamental approach to developing, supplying/distributing, marketing, and utilising services and goods. • Fostering stakeholder involvement is crucial for improving preparedness for change.	(Marcon, Dain and Frank, 2022) (Baz and Ruel, 2021)	• Implement a comprehensive change management strategy that includes educating stakeholders on the benefits of the new paradigm, fostering a culture of innovation, and involving employees in the transition process. Provide training and resources to help them adapt to the changes effectively.
5.	Supportive environment	• International businesses often struggle with establishing a collaborative ecosystem where various	(Xu, Vogel-Heuser and Wang, 2021)	• Foster a culture of collaboration through incentives, shared goals, and standardised digital platforms. Develop industry-wide data

		stakeholders, including suppliers, partners, and regulatory bodies, seamlessly interact and share data for effective digital transformation in supply chain management.		sharing and communication protocol standards to encourage a cohesive ecosystem.
6.	Organisational Factors	• In international businesses, there is often a lack of meaningful engagement with strategic intent, equitable contributions from all stakeholders, and fair appropriation of roles and rewards, hindering the co-created value through digital transformation in supply chain management.	(Shashi et al., 2020)	• Implement a collaborative approach, ensuring meaningful stakeholder engagement and aligning business needs, interests, and processes across the international value chain. Develop transparent and equitable frameworks for roles and rewards to enhance cooperation and value creation

The table above emerges as an essential analytical tool that helps us navigate the complexities and challenges that international companies experience when they revamp their supply chain operations to keep up with the advancements in the digital realm. The scheme below lists the problems in order, and the solution below for each gives a further explanation, the sources, and how the issue can be alleviated. To answer such fundamental issues as resource scarcity, readiness for the digital environment, ICT capabilities, chances for a paradigm shift for digital integration, fostering a nurturing space, and, of course, organisational issues that affect digital transformation are what this section does. Thus, this table demonstrates that it is critical to assess the issues and that there is a need to link them back to specific solutions that could be used to overcome these obstacles. Therefore, the table stands at the forefront for accomplishing the dissertation's study objective, which is to discuss all the difficulties of digital transformation and recommend practical approaches to overcome the existing problems. It is an excellent contribution to the subject area under study.

5.4 OBJECTIVE 3: METHODOLOGIES EMPLOYED BY SUCCESSFUL ORGANIZATIONS IN MANAGING DIGITAL TRANSFORMATION OF SUPPLY NETWORKS

5.4.1 INTRODUCTION

Given the challenging business environment, which appears among the large numbers of competitors in the market that have come with the technology revolution, a digital supply chain transformation has become a strategic priority. These approaches empower adopting the latest innovations and integrating transformative technologies while acting as a lever to enhance overall efficiency and competitiveness and maintain business resilience.

5.4.2 STRATEGIC PLANNING AND ROAD MAPPING: ALIGNING VISION WITH EXECUTION

A digital transformation strategy is deploying new technologies and a visionary and long-term targets-based approach based on the organisation's key objectives. A winning plan would show the step-by-step path of the phased rollout of digital technologies, fruitfully implementing each step and offering the possibility of immediate improvements and the ability to take advantage of the changing market and technology spheres. Therefore, this form of strategic alignment guarantees that each investment in technology is return-oriented through reduced costs, increased productivity or overall customer satisfaction (Nambisan et al., 2019).

On the one hand, strategic mapping road is vital, but at the same time, it can be overbearing when excessively followed. The rapid progress of digital innovation requires flexibility in strategic planning, wherein one can anticipate sudden modification in responses to technological innovations and Changes in the market's fundamentals. Organisations should focus on intertwining the formal strategies for exploitation of the opportunities with the flexibility of reacting to unpredictable market circumstances (Johnson & Haug, 2021).

5.4.3 AGILE IMPLEMENTATION FRAMEWORKS: ENHANCING RESPONSIVENESS

Adopting agile methodologies urges organisations to become more flexible during the digital transformation journey. Agile methods facilitate iterative development, frequent test cases, and the incorporation of feedback, implying that they are compatible with the dynamic aspects of requirements and today's abilities. This means it doubles the speed of digital integration and may also help avoid risks using gradual adaptations before a final deployment (Ivanov et al., 2022).

On the other hand, adopting agile methodologies can imply critical cultural changes and be difficult for traditional organisations with a hierarchical structure. Sticking to agile theories for the

entire duration will depend on the organisation's building a culture that observes collaboration, continuous learning, and the readiness to welcome change (Sarkis-Onofre et al., 2021).

5.4.4   DATA-DRIVEN DECISION MAKING: UNLOCKING VALUE FROM DATA

At the core of digital transformation is a function of data collection, analysis, and utilisation of data that can improve the making of decisions. Brilliant analysis with AI technology can tell a lot more than other methods by sorting through significant quantities of data and unveiling valuable insights that help in making better everyday decisions and making the process more effective(Javaid et al., 2022; Ivanov et al., 2022; Saeed et al., 2023; Rezaei & Faghihi-Nezhad, 2022; Baz & Ruel, 2021). The effective use of data is not only an operational enhancement criterion but also plays a significant role in developing innovative ideas and creating new value propositions (Seyedghorban et al., 2019).

On the one hand, data-driven decision-making brings advantages; on the other hand, data quality, privacy and security, are dealt with in this challenge. Organisations must establish effective data governance frameworks to solve this problem, helping them adhere to global data protection regulations and achieve data integrity expectations (Mangla et al., 2022).

5.4.5   CONTINUOUS LEARNING AND INNOVATION: FOSTERING A CULTURE OF INNOVATION

Innovation hubs and labs are a core component of building a culture of innovation within organisations. These experimental lab teams are used to find new ideas and technologies, and their experiments enable the business, creativity, and problem-solving to run smoothly. On the one hand, a measurement of an innovative culture will result in the ability to adapt to the fast-moving pace of technological development. On the other hand, it can empower employees to participate in the transformation process (Birkel & Müller, 2021).

On the one hand, it is undeniable that innovations provide a strong impetus. On the other hand, adopting new ideas in an enterprise environment may cause so-called "innovation isolation" when those bright ideas developed in laboratories do not easily sync with the business's daily operations. Innovation efficiency necessitates scalability and the alignment of these innovations with the company's business strategies to yield a positive impact on the business's objectives (Wang et al., 2020).

5.4.6 STAKEHOLDER ENGAGEMENT AND COLLABORATION: ENSURING COMPREHENSIVE INVOLVEMENT

This process happens for every company, ending with suppliers, customers, and collaborators. Involving these stakeholders is essential in multiple ways; it provides common goals, overcomes resistance to change, and guarantees a continuous flow of digital processes. Joint meetings, training classes, and planning sessions should be held regularly to familiarise all the stakeholders with what is happening and keep them involved (Faruquee et al., 2021).

Forming stakeholder engagement frameworks requires thorough research and an understanding of the interests and demands of diverse stakeholders. The lack of a precise alignment between digital transformation goals and stakeholders' expectations makes people more reluctant, which may cause the digital initiative strategy to fail (Loonam & O'Regan, 2022).

5.5 SUMMARY

The chapter aims to provide deeper insights into digital supply chain management, an essential operational direction for international businesses. By researching the triggers of digital SCM adoption and its natural benefits, the conversation emphasises the absolute importance of digitisation to improve supply chain efficiency and flexibility worldwide. We apply multi-faceted

impacts beyond mere one-of-operational efficiencies or market competitiveness as one of the three central pillars of such digital SCM to organisations working on an international level. Analysis of the methodologies used by best-placed organisations, exploration of digital improvements which make it possible to use them, and the challenges faced during the implementation are closely and systematically examined to ensure the point of view is more balanced. Therefore, this innovative research creates a holistic understanding of digital supply chain management in academics and is valuable to companies looking to develop a practical implementation of these strategies. This topic is situated within an objectively argued discourse which seeks to shed light on the revolutionary potentials of digital SCM and its impact on streamlining international business processes.

6 CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 INTRODUCTION

To conclude my study into integral digital transformation in the supply chain industry, it is apparent that this transformation is not just another fad. A massive paradigm shift is revolutionising how the world does business and affects global trade. This study systematically dissects the various aspects of digital SCM, ranging from what is needed to induce manufacturing to eradicate the challenges to be expected during and after which it can be implemented. Contents with well-rounded discussions from a systematic literature review, an articulate sector analysis, and rational discussions develop a comprehensive understanding of the digital transformation that profoundly impacts international supply chains.

6.2 CONCLUSION

This study's comprehensive exploration and analysis arrived at a conclusion that resonates with the primary objectives, research questions, and proposed hypotheses. The primary objectives of the research were threefold: firstly, to explore the advantages and opportunities stemming from the progression of digital supply chain management; secondly, to identify and examine the challenges confronted by enterprises in their pursuit of digital transformation; and thirdly, to understand the methodologies employed by successful organisations in managing the digital transformation of their supply networks. The ultimate aim was to contribute practical guidance to multinational corporations, enabling informed strategic decision-making and fostering the development of more resilient, efficient, and innovative global supply chains.

Aligned with these objectives, the research was structured around three key questions, each serving as a crucial component of the investigation into the multifaceted dimensions of digital supply chain management. The questions served as a roadmap guiding the systematic exploration of

opportunities and challenges inherent in the digital transformation of supply chain management. The research study focused on the reasons or motivations of multinational organisations adopting digital supply chain management. The forum raised the importance of a well-erected supply chain for a global business and, by implication, required one to be conversant on the crucial components and interdependencies of a supply chain.

The findings served as evidence that supported the hypotheses, demonstrating a methodical relationship between the successful integration of Digital Transformation and Increases in Performance, Agility and generally overall implementation in international trade businesses. The undertaken research also revealed the intervening functions of certain industry-specific factors and suggested the likely contradictions in the cases of efficiency, resilience, adaptation and unforeseen consequences that result in poor competitiveness by international businesses.

Digital Transformation in SCM shows a once-concealed area that now displays a crossway of strategies and interactive technologies where planning converges with operational execution, posing the duality of challenges and opportunities. Digital technologies like blockchain, IoT, and AI not only afford the tools but are exponents of the relationships between the suppliers, customers, and other stakeholders. Enabling them to distinguish between effectiveness, speed, and collaboration parameters leads to expectations for competitive advantage and sustainability. Consequently, adopting digital SCM to introduce revolutionary changes is fraught with hazards, including a budget-busting investment, new skill acquisition, and change management in corporate cultures.

Successfully implementing digital transformation involves more than a mere adoption of technology; it entails a fundamental reexamination of business models and operations based on a strategy. Businesses have to adopt an overall strategy for incorporating digital technologies.

Consequently, they should compose of a smart implementation master plan, agile strategy, and a long-term atmosphere for innovation. Leadership that spurs such a cultural change is responsible for a process for which flexibility, adaptability to novel circumstances, and digital transformation are crucial factors, hence, devising strategies for the organisation is essential.

However, going forward, it will be more critical for carrying out the reform on an ongoing basis, along with the system of multi-faceted collaboration. In undoubtedly regarded the fact that digital platforms improvement has obtained the paramount society the issue at same time which defines necessity for skills development of those who are in the heading positions and the basic function of the concern. Development and training activities are useful to form a team that effectively refers to new approaches. Furthermore, this participation includes not only endorsement of such changes by the stakeholders but their full engagement in the innovation, as well as in the integration of process-oriented digital supply chain management with strategic projects in the whole enterprise.

6.3   RECOMMENDATION

Faced with these issues regarding how the digital transformation of supply chain management affect international businesses, organizations should have a careful look into the recommendations below which are designed to help them survive through the complexity of this process. Digital talent acquisition and training programs are areas where organizational investment is of the utmost necessity, cognisant of the fact that highly skilled employees are those who will play the pivotal role during the digital supply chain initiatives. Sufficient measures in cybersecurity should be emphasised in order to protect electronic assets and sensitive data properly, developing a security culture within the organization that is characterized by the awareness and compliance. Beyond these, it is paramount for organizations to be fleet-footed in their supply chains through the

adoption of agile and adaptable strategies aided by digital transformation to identify operational bottlenecks and be more responsive to market volatility.

Simultaneously, the creation of inter-stakeholder and cross-industry alliances is vital to achieve, so the agreement on shared standards and information sharing through digital platforms should be made among stakeholders. Recognition and utilization of industry-specific factors are imperative to tailor digital strategies to each sector's unique characteristics. Striking a balance between efficiency and resilience is vital, acknowledging potential trade-offs and maintaining adaptability in disruptions. Implementing innovative technologies, including Industry 4.0 advancements, can optimise supply chain processes and decision-making.

Enhancing customer experience through digitalisation, establishing governance structures supported by blockchain, and promoting environmental and social sustainability are additional recommendations to capitalise on the transformative potential of digital supply chain management. By implementing these recommendations, multinational corporations can strategically position themselves to build more resilient, efficient, and innovative global supply chains in the rapidly evolving digital landscape.

6.4   FUTURE DIRECTIONS

Going ahead, wider usage of digital SCM will be expected by most industries. Apart from this, new industries will also recognise their worth in tackling everyday operational issues and attaining competitiveness at the global level. The attention of further research at the time of implementation of the digital supply chain management is to be made towards the longitudinal studies so that the impacts over a long term are known, and the knowledge is generated with a better understanding of how digital transformation influences the resilience of organisation and adaptability of markets.

Not only that, but a deeper analysis of underlying ethical issues such as data protection, technology security, and drawbacks of human resources automation is essential in developing new territory for business people.

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