Barriers to Digital Transformation Implementation in Operations and Supply Chain Management: A Systematic Literature Review (SLR)

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Abstract

Purpose – This study seeks to identify and summarize the principal barriers to the implementation of digital transformation in operations and supply chains.

Methodology – This research utilizes a Systematic Literature Review (SLR) methodology in accordance with PRISMA criteria. A thorough literature search was performed utilizing the Google Scholar database, concentrating on peer-reviewed articles released from 2019 to 2024. Studies were evaluated according to established inclusion and exclusion criteria. From the initial collection of discovered papers, 20 studies were chosen and examined to systematically discern reoccurring themes and categories of obstacles to digital transformation.

Findings – The analysis indicates that digital transformation in operations and supply chain management is obstructed by several significant barriers, including inadequate digital capabilities, resistance to organizational change, interoperability challenges, insufficient infrastructure readiness, and cybersecurity issues. These obstacles diminish operational efficiency, disrupt process integration, and undermine supply chain resilience, thereby restricting the potential advantages of digital transformation programs.

Originality – This study enhances the literature by offering a systematic synthesis of challenges to digital transformation in operations and supply chain environments. The study consolidates fragmented information, emphasizing notable research gaps about the varying effects of different barriers on the efficacy of digital transformation. The findings provide significant insights for scholars and practitioners, indicating pathways for future study aimed at creating comprehensive frameworks for evaluating and alleviating impediments to digital transformation.

Introduction

The advent of digital technology, amidst fast evolving and uncertain market dynamics during recent decades, has necessitated enterprises improving their agility, expedite decision-making, and developing more efficient and responsive procedures. Digital transformation, using real-time data, predictive analytics, digital twins, and the integration of information systems, is

increasingly essential for firms to maintain operational resilience and sustainability in the face of global complexity.

To sustain competitiveness, companies must leverage digital technologies, including automation, cross-functional data integration, and improved operational visibility, to streamline processes and optimize workflows throughout the supply chain ecosystem. Digital technology enables the integration of previously disjointed operations, fostering enhanced communication among stakeholders and promoting more precise planning and control amid demand fluctuations and external disturbances (Lu, 2017). Consequently, digital transformation enhances efficiency while promoting the development of more adaptable and interconnected supply chains.

The digitalization of the supply chain has transformed the way firms execute operational procedures. Digital technology enhances collaboration, reduces uncertainty, and accelerates corporate reactions to market changes by utilizing real-time information, sophisticated analytics, process automation, and network connectivity. This modification establishes a more flexible, responsive, and transparent supply chain system, prompting firms to cultivate new, more agile and data-driven operational models (Maroufkhani et al., 2022). This paradigm shift indicates that digitalization has emerged as a crucial foundation in the management of contemporary supply networks.

Digital transformation also contributes to the dissolution of conventional boundaries inside supply chain frameworks. The amalgamation of digital platforms, automated monitoring systems, and cross-process interconnection facilitates the establishment of a broader and more accessible information network. This network improves visibility, diminishes coordination obstacles, and establishes a basis for more intelligent, data-informed decision-making. The adoption of digital twins and predictive technology has allowed firms to simulate disruption scenarios in real-time, hence improving risk mitigation strategies and supply chain resilience in harsh situations.

Despite the substantial advantages of digital transformation, its execution within diverse businesses often encounters challenges. Numerous challenges emerge, including insufficient human resources for comprehending new technologies, resistance from organizational culture, substantial investment costs, poor infrastructure preparedness, and increasingly intricate data security and privacy concerns in a connected digital landscape. Prior studies indicate that these obstacles might directly affect the effective execution of digitalization, especially in operational and supply chain management, which necessitate high levels of consistency, integration, and reliability in service provision (Kamble et al., 2018). This affirms that the efficacy of digitalization relies not solely on technology, but also on the comprehensive preparedness of the business.

Challenges in the application of digital technology stem from external sources, including inconsistent industry standards, insufficient regulatory backing, cybersecurity threats, and the rapidly evolving demands of the corporate landscape. The intricacy of the global digital environment necessitates that firms exhibit significant agility and advanced risk mitigation measures. Moreover, organizations encounter challenges in assimilating legacy systems with contemporary digital platforms, frequently resulting in inefficiencies and technological impediments during the change process (Boyes et al., 2018). These technical obstacles complicate the efforts to update operating processes.

Previous study has highlighted the advantages of digitalization and artificial intelligence in enhancing supply chain accountability, transparency, and sustainability. Nevertheless, comprehensive discourse around the obstacles to executing digital transformation has not yet emerged as a central emphasis. The effectiveness of digital transformation is significantly determined by organizations' ability to identify, comprehend, and surmount these challenges. The lack of extensive study on implementation issues signifies a substantial research deficiency.

This study seeks to systematically synthesize the obstacles to adopting digital transformation in operations and supply chain management through a PRISMA-guided Systematic Literature Review (SLR) approach. The study seeks to identify, classify, and examine various barriers identified in literature, thereby offering a comprehensive understanding of the reasons obstructing successful digitalization. The research findings are anticipated to enhance both theoretical and practical aspects of developing more effective, adaptive, and sustainable strategies for digital transformation implementation.

Literature Review

Digital transformation in the supply chain necessitates the integration of technologies such as IoT, big data analytics, and intelligent systems to enhance operational efficiency and visibility. Nonetheless, its deployment has encountered challenges, frequently confronting organizational, technical, and financial obstacles, as evidenced by Eryc & Deu (2024), who established a taxonomy of digital barriers categorized into four primary types and underscored that internal readiness is a crucial determinant in the effective adoption of technology. This study establishes a crucial foundational framework for comprehending the many aspects of digital barriers in a more organized manner.

Study Martins & Frederico (2023) expands the understanding of barriers by analyzing their connection to sustainable initiatives within the supply chain. The adoption of digital technology is frequently impeded by substantial initial costs, the intricacy of integrating sustainable processes, and insufficient human resource preparedness to execute digital-based circular economic activities. This discovery indicates that digital implementation encounters not only technological difficulties but also obstacles in reconciling economic and environmental objectives.

The operational context's implementation barriers are delineated by Huang et al. (2024), which cites limits associated with worker skill deficiencies, system interoperability, and difficulties in transitioning technology testing to comprehensive implementation within supply chain operations. This study affirms that technical and human factors hold equal significance in the operational digital transformation process. This indicates that digital transformation necessitates advanced operational capabilities to prevent stagnation at the pilot project phase.

The organizational preparedness approach, as elucidated by Piyathanayong et al. (2024), underscores the significance of digital maturity as a prerequisite for effective deployment. Many firms were found to be incapable of effectively leveraging digital technology due to insufficient analytical capabilities, inadequate data governance, and a misalignment between managerial strategy and technological competencies. This study emphasizes the internal deficiencies that frequently result in the unsuccessful implementation of digital transformation.

In contrast to other studies that concentrate on identifying obstacles, Jaziri et al. (2024) presents a solution-oriented methodology by assessing mitigation measures available to companies. They underscored the significance of phased deployment, digital competency

training and development, and collaboration with technology partners as strategies to alleviate the risks associated with supply chain digitalization failure. This methodology substantially enhances practical advice in operations management and supplements the literature, which has predominantly concentrated on identifying problems rather than offering solutions.

Research Methods

This study uses the Systematic Literature Review (SLR) methodology as the principal strategy to investigate the obstacles to executing digital transformation in operational and supply chain management. The SLR approach was selected for its capacity to methodically filter and synthesize diverse study data, thereby thoroughly addressing the research objectives [13]. This research adheres to the Preferred Reporting Items for methodical Reviews and Meta-Analyses (PRISMA) criteria to provide transparent and methodical reporting and source selection methods.

Data was sourced from a singular primary repository, Google Scholar, selected for its extensive range of national and international publications. The search approach employed the keywords: "digital transformation," "supply chain," "operations management," and "implementation barriers." The search was confined to publications from 2019 to 2024, exclusively incorporating full-text items pertinent to the study's subject. Articles failing to satisfy the inclusion criteria were omitted from the analytical procedure.
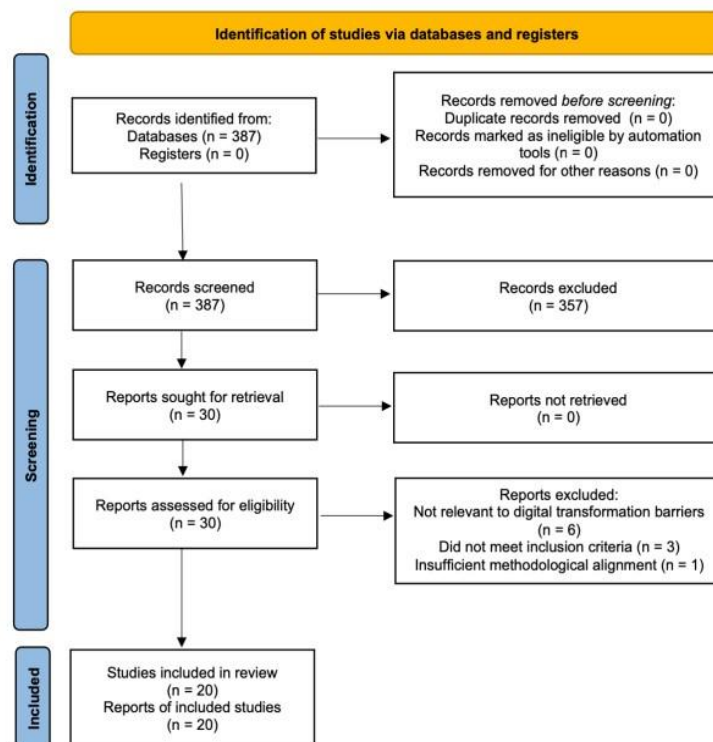

Figure 1. PRISMA Flowchart

The article identification and selection process was executed according to the four steps of PRISMA 2020. During the identification phase, the preliminary search produced 387 papers from Google Scholar utilizing keyword and year constraints. The papers underwent a screening process based on their titles and abstracts, leading to the exclusion of 357 articles that were deemed irrelevant to the issue of hurdles to the implementation of digital transformation in

operations and supply chain management. Thirty articles advanced to the preliminary review phase.

A comprehensive evaluation of the article's full-text content is performed at the eligibility stage to ascertain its alignment with the research focus. Ten items were excluded due to irrelevant discussions or failure to meet other inclusion requirements. In the concluding phase, 20 principal papers were acquired and utilized as the foundation for analysis in this study.

To guarantee the precision of the analysis, each selected article underwent a data extraction process that involved identifying themes of barriers, categorizing causal elements, and delineating the research setting. The findings of this synthesis establish the basis for developing a thorough comprehension of the elements that obstruct the effective execution of digital transformation in operational and supply chain management.

The research methods section describes the main stages and procedures of the research to investigate a research problem and the rationale for the application of specific procedures or techniques used to identify, select, process, and analyze information applied to understand the main problem of the research. In detail, research methods must be explaining the methods used, the influences that determined your approach, and why you chose samples, etc. This section must focus on answers about collected or generated data, and the process to analyze data with the relevant analytical tools. The writing should be direct and precise and always written in the past tense.

Results and Discussion

Recognizing Obstacles to the Execution of Digital Transformation

Digital transformation in operational management and supply chains is increasingly seen as a strategic component to enhance transparency, information precision, and process efficiency. Nonetheless, numerous studies indicate that the use of digital technology encounters certain fundamental challenges that hinder the digitalization process from proceeding as anticipated. The challenges arise from technical, organizational, financial, and regulatory factors, continuously manifesting across diverse industrial sectors, including manufacturing, logistics, and small to medium-sized firms (Mahwati, 2024).

A commonly referenced obstacle in literature is the inadequacy of internal digital capabilities, especially with the technical proficiency of the workforce in managing intricate digital systems. Studies on the application of digital twins in the food sector indicate that organizations are encountering difficulties in maximizing this technology due to a deficiency of qualified staff and the subpar quality of data available for constructing digital models (Mangla et al., 2022). Comparable challenges were identified in the implementation of Industry 4.0 technologies within a circular economy framework, where insufficient digital literacy was a significant impediment to the integration of new technology with established corporate processes (Piyathanayong et al., 2024). In the realm of manufacturing SMEs, insufficient technical proficiency results in a sluggish and unfocused digitization process (Borana et al., 2024).

Moreover, organizational resistance to change constitutes a substantial impediment commonly identified in numerous studies. Research regarding blockchain-based digitalization indicates that employees and managers frequently lack readiness to embrace alterations in work processes, resulting in resistance to new technologies, which are viewed as necessitating considerable adaptation and disrupting established routines (Sunmola et al., 2021). Research in the Bangladeshi garment sector indicates that resistance is heightened when enterprises fail to

offer sufficient training or clear communication about the objectives and advantages of digitalization, hence impeding the adoption of new technology (Huang et al., 2024).

The subsequent challenge is to infrastructure preparedness and technological integration, especially for entities dependent on legacy systems. Research on the tea supply chain seeking to implement blockchain technology identified that infrastructural constraints, platform incompatibility, and variations in system architecture obstructed the real-time information flow essential for supply chain oversight (Chen et al., 2021). The implementation of a Manufacturing Execution System (MES) in small and medium-sized enterprises has significant challenges due to the inconsistency in data formats, hindering the integration of new systems with legacy systems and obstructing optimum data assimilation (Salman et al., 2024).

In addition to the technical aspect, financial obstacles significantly impede digitization initiatives. Investigations into the use of Industry 4.0 technology in Tunisian SMEs indicated that substantial initial investment costs, ongoing maintenance charges, and uncertainty over return on investment deter enterprises from embracing new technologies (Farea et al., 2023). This challenge also occurs within supply chain digitization efforts associated with sustainability objectives, as organizations find it difficult to appropriate money for system enhancements and workforce development.

A notable challenge is cybersecurity and data privacy hazards, which are essential issues in an increasingly linked digital landscape. Research on the integration of AI in logistics operations indicates that organizations are concerned about cyberattacks, data manipulation, and other information breaches that could impede operations (Jerbi & Elmsalmi, 2024). This issue is exacerbated by the absence of clear and consistent regulatory requirements in digital data management, as evidenced by study on digital supply chain impediments in Saudi Arabia (Wang et al., 2022).

The growing barriers have a consistent pattern, despite their origins in diverse industrial environments. This framework establishes a basis for systematically categorizing these diverse obstacles, so enhancing the clarity of their attributes. Consequently, the subsequent part classifies the recognized obstacles to offer a more systematic perspective on the nature and extent of digital transformation issues.

Category Challenges Execution Digital Transformation

The uniformity of obstacle patterns identified in various research facilitates a more systematic categorization of the obstacle's firms have in executing digital transformation. This categorization is essential for elucidating the attributes and extent of the challenges, thereby assisting companies in devising suitable mitigation solutions. According to a synthesis of literature, obstacles to the implementation of digital transformation can be classified into four primary categories: technological hurdles, organizational and human resource barriers, financial barriers, and security and regulatory constraints.

The initial category encompasses technical hurdles, which comprise limits associated with technology capability, infrastructure preparedness, and system integration. Numerous studies indicate that technological constraints predominantly result from firms' inadequacy in assimilating new technology with their existing legacy systems. Research on blockchain-enabled tea supply chains indicates that deficiencies in data integration capabilities, disparities in system architectures, and insufficient digital infrastructure are the primary factors hindering enterprises

from effectively leveraging this technology (Chen et al., 2021). In small and medium-sized enterprises, technological obstacles are apparent in the implementation of Manufacturing Execution Systems (MES), as data format incompatibility impedes proper integration (Salman et al., 2024). This signifies that digital transformation necessitates technical preparedness, which includes hardware, software, data standards, and system compatibility.

The second category encompasses organizational and human resource constraints, highlighting the impact of work culture, organizational structure, and workforce competencies on the efficacy of digitalization. Challenges in this category manifest as reluctance to change, insufficient technical capabilities, and inadequate management support. Research on the use of blockchain technology in supply chains indicates that firms frequently encounter opposition from employees who feel ill-equipped to relinquish manual methods, particularly when changes occur without sufficient training and support (Sunmola et al., 2021). A study on the garment industry indicated that businesses' failure to manage change processes and deliver pertinent training is a significant barrier to the adoption of digital technology (Huang et al., 2024). Consequently, organizational impediments pertain not only to technical proficiency but also to cultural preparedness and the structural framework necessary for transformation.

The third category encompasses financial hurdles, typically associated with initial investment costs, maintenance charges, and the unpredictability of the value derived from digital technology. A study on SMEs in Tunisia indicated that the substantial expense of adopting Industry 4.0 technology hinders numerous enterprises from initiating the digitalization process, despite their awareness of its potential advantages (Farea et al., 2023). Moreover, additional study indicates that organizations frequently encounter difficulties in budgeting for digital device development, employee training, and infrastructure enhancements, as the financial advantages are not always immediately evident. The financial constraint results in a higher prevalence of digital technology adoption among large enterprises, whilst SMEs are falling behind due to insufficient capital.

The fourth category encompasses security and regulatory obstacles, including the threat of cyberattacks, apprehensions regarding data privacy, and the ambiguity in legal frameworks governing digital technology utilization. In studies regarding AI integration in logistics, firms articulated considerable apprehension over cyber threats and the possibility of data manipulation that could impair operations and tarnish corporate reputation (Jerbi & Elmsalmi, 2024). A study employing the Interpretive Structural Modeling (ISM) methodology to examine digital supply chain impediments in Saudi Arabia identified policy ambiguity, security requirements, and legislation as substantial barriers that deter firms from complete digitization (Wang et al., 2022). The challenges in this domain signify that data security and regulatory clarity are essential elements that must be resolved for sustainable digital transformation to advance.

Classifying the impediments into these four categories offers a more methodical perspective on the intricacies of the issues associated with executing digital transformation. This classification enables a comprehensive investigation of the influence of each category on operational management and the supply chain. Consequently, comprehending these categories of impediments is a crucial prerequisite before assessing their influence on operational performance, which will be addressed in the subsequent section.

Effects of Obstacles on Operations Management and Supply Chain

The previously identified impediments hinder the technology adoption process and have substantial operational implications for operations management and the supply chain performance. These effects emerge in multiple ways, including reduced process efficiency, restricted information visibility, and diminished supply chain resilience amid fluctuations in the economic environment. Numerous studies indicate that when obstacles to digitalization are not systematically addressed, firms fail to obtain strategic advantages from the digital technology they use (Mahwati, 2024).

The major impact is diminished visibility and real-time monitoring capabilities in the supply chain. Research on digital twins in the food industry indicates that poor data quality and firms' failure to effectively integrate digital models result in delays in identifying operational disruptions and demand fluctuations (Mangla et al., 2022). In production, restricted system integration impedes a company's power to acquire precise data regarding material flow, thereby elevating the danger of capacity planning inaccuracies (Salman et al., 2024). This situation signifies that technical constraints directly affect operational monitoring and decision-making processes.

In addition to visibility, digital obstacles diminish operational efficiency and inter-unit collaboration. Research on the circular economy sector revealed that the absence of Industry 4.0 technology integration results in disjointed operational processes, thereby prolonging processing time, duplicating jobs, and escalating resource consumption (Piyathanavong et al., 2024). The repercussions of inefficiency are apparent in blockchain-enabled tea supply chains, where technological infrastructure incompatibility obstructs information flow, hindering optimal coordination among companies and their partners (Chen et al., 2021). This suggests that technical and organizational obstacles directly impair the efficacy of cross-functional coordination.

A further emergency consequence is diminished supply chain resilience, particularly in addressing external disturbances. Research on SMEs in Tunisia indicates that the lack of financial resources hinders enterprises from fully embracing digital technology, rendering them less resilient to demand variability and supply interruptions (Farea et al., 2023). Research on digitization for sustainability indicates that enterprises without data-driven analytical and monitoring capabilities are more susceptible to demand imbalances, heightened waste, and energy inefficiencies (Jaziri et al., 2024). This signifies that digital obstacles impact both everyday operational efficiency and the company's capacity to sustain supply continuity.

In addition to influencing resilience, obstacles to digital deployment also impair data-driven decision-making. Research on AI adoption in logistics indicates that insufficient data protection and cybersecurity concerns have led firms to refrain from employing sophisticated analytics, resulting in strategic decisions based on intuition or incomplete data (Jerbi & Elmsalmi, 2024). This failure to effectively leverage data obstructs firms from achieving accurate forecasting, production scheduling, and inventory management.

The ultimate effect pertains to sustainability and ecological performance. Research on supply chain transformation within a circular economy indicates that digital obstacles impede firms from maximizing resource efficiency, minimizing waste, and enhancing the monitoring of recycled materials (Holloway, 2024). When technology fails to integrate successfully,

operational processes cannot sustain long-term sustainability objectives, resulting in missed possibilities for enhancing material efficiency and diminishing environmental impact.

These findings demonstrate that obstacles to the adoption of digital transformation exert both direct and indirect effects on operational performance and supply chain resilience. These effects not only constrain the organization's operational efficiency but also diminish the strategic advantages obtainable from digitization, particularly regarding resilience, sustainability, and data-driven decision-making. Consequently, comprehending the influence of these obstacles is essential for firms to formulate targeted and contextually relevant mitigation strategies.

Conclusion

Recent research discoveries highlight a growing focus on digital transformation within operations and supply chain management, reflecting the rapid advancement of digitalization across diverse industrial sectors. The growing volume of publications addressing this area suggests that the obstacles to executing digital transformation are emerging as a pertinent strategic concern considering the needs for efficiency, resilience, and responsiveness to global market dynamics.

This study identified four primary kinds of impediments to the implementation of digital transformation in operations and supply chain management: technical, organizational and human resource, financial, and security and regulatory barriers. These constraints persist across diverse industrial contexts and significantly hinder firms from fully realizing the advantages of digitalization, including real-time visibility, process integration, data-driven decision-making, and enhanced supply chain resilience. Insufficient digital infrastructure, reluctance to adapt, inadequate digital literacy, and substantial investment expenditures are the primary factors influencing implementation efficacy.

Despite the potential of digital transformation to enhance operational efficiency, the investigation reveals that its implementation still fails to resolve all organizational difficulties. The observed impediments impact the constraints on information accuracy, inadequate interdepartmental collaboration, and the organization's diminished capacity to respond swiftly to disturbances. This condition asserts that effective implementation relies not solely on technological availability, but also on the preparedness of support systems, data governance, and a flexible organizational culture.

This study's findings reveal a deficiency in research about the interaction of these barriers and their impact on the overall efficacy of digital transformation. Furthermore, there is a paucity of research examining mitigation techniques that businesses might adopt to surmount these obstacles. Consequently, forthcoming research must focus on establishing a more cohesive framework for assessing organizational readiness, identifying risk factors, and devising more adaptive and sustainable implementation strategies.

Moreover, subsequent study should consider the industrial environment, organizational scale, and digital maturity level, as each of these elements may provide distinct variations in obstacles. An empirical methodology, comprehensive case studies, or quantitative techniques utilizing a bigger sample can yield a more precise understanding of the dynamics of digital adoption in operational settings and supply chains. Consequently, forthcoming study findings are anticipated to enhance theoretical contributions and offer practical advice that will assist firms in formulating more effective, resilient, and competitively advantageous digital transformation plans.

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