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Digitalization as a Meta-Capability: Integrating Theoretical Perspectives to Enhance Supply Chain Performance and Production Quality

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Abstract

Over the past decade, firms in manufacturing and other sectors have invested heavily in digital technologies to improve supply-chain performance and production quality. Yet empirical evidence shows that similar digital tools often lead to uneven gains in efficiency, agility, and quality, indicating that technology alone does not guarantee better outcomes. These mixed results highlight the need for integrative frameworks that explain when and how digitalization actually translates into superior operational and quality performance. Digital transformation is redefining how organizations design, produce, and manage performance. Yet its benefits often differ widely across firms. This paper develops a conceptual framework that explains digitalization as an organizational meta-capability, integrating technological resources, adaptive processes, and information use. Drawing on the Resource-Based View (RBV) and the Dynamic Capabilities Theory (DCT), the study argues that digitalization enhances performance through learning, coordination, and strategic alignment rather than technology alone. The model highlights five key outcomes of digital transformation within supply chains: cost efficiency, agility, quality, sustainability, and collaboration. By linking these dimensions to core theoretical foundations, the paper provides a holistic understanding of how digitalization creates lasting value. The discussion also offers managerial insights on how firms can leverage digital capabilities to achieve both operational excellence and long-term resilience in rapidly changing environments.

Keywords: Digitalization, Meta-capability, Supply chain performance, Production quality, Resource-Based View (RBV), Dynamic Capabilities Theory (DCT)

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1. Introduction

Despite the rapid technological advances of the past decade, many organizations still struggle to align digitalization initiatives with meaningful improvements in both supply chain performance and production quality (Ning & Yao, 2023; Wang & Prajogo, 2024; Mugurusi et al., 2021) The promises of automation, predictive analytics, and real-time information flow are frequently undermined by fragmented implementation strategies and conceptual silos in the academic literature. While Industry 4.0 technologies such as the Internet of Things, artificial intelligence, blockchain, and advanced analytics have redefined operational possibilities, their transformative potential remains unevenly realized across sectors (Zeng et al., 2024), (Mugurusi et al., 2021).

Academic inquiry into these topics has largely evolved along parallel tracks. The digitalization literature has focused on the adoption and integration of digital technologies to enhance visibility, coordination, and responsiveness (Wei et al., 2024). The supply chain performance literature has examined efficiency, agility, and resilience outcomes, often independent of technological drivers (Danandjojo et al., 2024). Meanwhile, the production quality literature has focused on defect prevention, compliance, and customer satisfaction, rarely linking these to digital infrastructure (Wang, 2024). This separation has resulted in a notable theoretical and managerial blind spot: a lack of integrated models explaining how digitalized information systems simultaneously influence multiple dimensions of performance and quality.

This fragmentation poses challenges for both scholars and managers. Theoretically, the field lacks a framework that explains how digital capabilities are developed, combined, and transformed into measurable results. Managerially, firms often invest in technology without a clear sense of how those investments will create value or improve quality outcomes. These gaps lead to a central question that motivates this paper: how can digitalization, understood as an organizational meta-capability, bring together different theoretical perspectives to explain and strengthen supply-chain performance and production quality? Addressing this question calls for a conceptual approach that connects digital resources, adaptive processes, and information flows within complex business environments

To explore this issue, the paper treats digitalization as a meta-capability that orchestrates and enhances other strategic and operational competences. It draws on three complementary perspectives: the Resource-Based View, Dynamic Capabilities Theory, and Information Processing Theory.

The purpose of this review is to bridge these theoretical and empirical silos by critically synthesizing the literature on digitalization, supply chain performance, and production quality. Specifically, it seeks to: (1) consolidate cross-disciplinary insights into a coherent conceptual framework; (2) identify thematic and methodological gaps that hinder theoretical integration; and (3) propose a multi-dimensional model linking digitalization to operational, quality, and sustainability outcomes. The review adopts a multi-industry perspective, covering manufacturing, healthcare, agri-food, and service sectors, and draws on peer-reviewed studies published over the past two decades. Studies were included if they addressed at least two of the three core constructs (digitalization, performance, and quality) directly or via mediators such as agility, resilience, or ESG factors.

By situating digitalization as a strategic meta-capability and embedding it within a network of interdependent performance dimensions, this review offers both academic and practical contributions. For scholars, it integrates fragmented theoretical streams into a unified lens for studying digital supply chains. For practitioners, it provides a roadmap for aligning technology investments with holistic performance and quality gains.

2. Conceptual and Theoretical Foundations

2.1 Key Concepts

In the literature, scholars often distinguish between digitization and digitalization, though the two terms are frequently used interchangeably. Digitization refers to the technical act of converting analog information into machine-readable form, enabling data to be stored, transmitted, and retrieved electronically (Vrana & Singh, 2021; Ciocnitu, 2024). While important as a first step, digitization alone rarely transforms how firms operate. By contrast, digitalization represents a more profound socio-technical shift. It describes the embedding of digital infrastructures into business processes, decision-making systems, and inter-organizational coordination in ways that generate new forms of value (Bockshecker et al., 2018; Spath et al., 2021; Gillani et al., 2024).

In supply chains, digital tools often mean IoT sensors, blockchain records, AI programs, big data platforms, and cloud systems. They help managers see more, track better, and react faster (Zeng et al., 2024). Performance in supply chains is not only about cost and speed. It also covers how well materials, money, and information move. Before, companies looked at cost control, delivery times, and lead time reduction. Now the focus also includes agility, resilience, and sustainability because of global competition and pressure to cut environmental damage (Gupta et al., 2020). In digital settings, other points matter too: data accuracy, how well systems connect, and the ability to decide quickly with real-time information (Mhaskey, 2024).

Production quality has changed in much the same way. Quality is no longer reduced to checking whether a product meets technical standards. In practice, customers want proof that operations run reliably and that flaws are stopped before they spread (Tailor & Chauhan, 2024; Sundaram, 2023). Regulators also look for consistency, while buyers put a premium on dependability and trust (Ullagaddi, 2024). Increasingly, attention is also placed on how factories handle environmental rules and whether they respect fair production standards (Egbumokei et al., 2024). Digital tools play a role here as well. They help keep machines in good condition through scheduled care, make it possible to watch performance in real time, and notify staff when something unusual appears, so issues are fixed before they grow (Arena et al., 2022; Mathew & Kaur, 2024; Sicard et al., 2022).

To close, it is worth drawing a line between two ideas. Digitization can be understood as the technical step of translating data into formats that can be stored and transmitted electronically. Digitalization, in contrast, is about rethinking business processes, and this change directly shapes supply chain performance and production quality. The first concerns the technical conversion of data, while the second concerns organizational transformation, which has clear effects on both supply chain outcomes and production quality.

2.2 Theoretical Perspectives

Understanding how digitalization affects performance and quality requires theoretical grounding. Three major perspectives provide the foundation for this paper: the Resource-Based View (RBV), Dynamic Capabilities

Theory, and Information Processing Theory. Each contributes a different lens through which to understand how digital technologies generate value.

According to RBV, a firm secures advantage when it possesses resources that are valuable, rare, inimitable, and non-substitutable (VRIN) (Cardeal & António, 2012); (Mat et al., 2022). In digital supply chains, these resources often take the form of advanced information systems, data analytics, and unique algorithms that help firms improve coordination, forecasting, and decision-making (Wang & Prajogo, 2024); (Srimarut & Mekhum, 2020); (Ali & Ahmed, 2022). Yet the simple possession of these tools is not sufficient. Unless they are embedded in daily operations and supported by managerial know-how, they quickly lose distinctiveness (Nielsen, 2010); (Degravel, 2011). These resources become truly valuable when they are used together with organizational practices, since this makes them much harder for competitors to imitate (Lima et al., 2025); (Feiz Abadi & Cordon, 2014).

Extending the RBV, Dynamic Capabilities Theory emphasizes the importance of continuously reconfiguring and adapting resource bases to cope with volatile environments (Alshaar & Alkshali, 2024), (Ghobakhloo et al., 2023). In the context of Industry 4.0, dynamic capabilities can be seen in the ability of firms to detect shifts in technology and markets, to act quickly on such opportunities, and to modify routines so that new digital practices become part of everyday operations (Dubey et al., 2023), (Piprani & Jaafar, 2025). Evidence from recent studies further shows that these capabilities strengthen agility, resilience, and quality management in supply chains, since the use of real-time data in logistics and production enables faster reactions to disruptions and earlier correction of quality problems (Gomaa et al., 2025 ; Nagy-Szentesi, 2025; Shovon et al., 2024).

The third perspective, namely Information Processing Theory, adds another dimension by exploring how firms deal with uncertainty using advanced digitalization technologies. Some firms lower their need for information by setting routines, while others boost their capacity to process more of it. Digitalization mainly supports the second path, as it expands the organization's ability to manage information (Schlegel, 2014), (Findler, 1966). Through IoT devices, advanced analytics, and integrated platforms, firms can detect risks early, anticipate breakdowns, and reallocate resources before disruptions spread (Fan & Zhou, 2024), (Retana & Saleeb, 2016). At the same time, these tools improve coordination and decision speed, helping firms become more agile and responsive in uncertain environments (Cui et al., 2015), (Rojas & Frein, 2008).

Viewed together, the three theoretical perspectives complement one another: RBV underlines the value of digital resources, DCT stresses the importance of continuous renewal, and IPT shows how richer information flows help firms cope with uncertainty.

2.3 Historical Evolution of Digitalization in Supply Chains

The journey toward digital supply chains has unfolded over several decades. In the late twentieth century, one of the most notable developments was the spread of ERP systems. These systems brought procurement, production, and logistics together under one database, something that had rarely been achieved before (Adenekan et al., 2024); (Murray et al., 2013). This change made it easier for firms to standardize their routines and to work with one common source of data across departments (Chinta, 2025); (Papadonikolaki, 2019). Efficiency and accuracy improved, but the systems were still limited, because most of the support they offered for decision-making was descriptive, leaving firms less agile in reacting to the changes (Sun et al., 2022); (Helo et al., 2006).

A second stage followed in the early 2000s with the rise of Advanced Planning and Scheduling (APS) systems, stronger Supply Chain Management (SCM) applications, and collaborative web-based platforms (Kristianto et al., 2011); (Jeong & Lee, 2002). These tools relied on greater computing power and better connectivity to link optimization models with real-time data, improving both local and global decision-making (Ivert, 2012); (Steger-Jensen et al., 2011). As a result, interactions between suppliers, manufacturers, and distributors became faster and more coordinated, supported by synchronized planning and visibility across the network (Santa-Eulalia et al., 2011); (Errington, 1997). Around the same time, scholars began to apply Information Processing Theory more actively to supply chains, stressing that firms were becoming dependent on systems able to manage complexity and uncertainty through richer and timelier information flows (Iyer, 2018); (Feng, 2003).

A third wave came with Industry 4.0, when tools like IoT, cloud computing, big data, and AI started reshaping supply chain practices. Instead of mainly linking processes, this stage focused on continuous monitoring and quick adjustment. Companies increasingly adopted predictive maintenance, advanced forecasting, and real-time quality checks as routine practices (Kaur et al., 2024), (Resende et al., 2021). IoT-enabled sensors and Radio Frequency Identification systems (RFID) provided unprecedented visibility into material flows and production conditions (Lomte, 2025), while AI algorithms started to generate prescriptive insights that allowed decision-makers to anticipate and address disruptions proactively (Suthar et al., 2024).

Today's fourth wave is defined by the rise of Digital Twin technology, high-fidelity, virtual counterparts of physical assets, processes, and even entire supply networks. Unlike earlier forms of digital modelling, digital twins are continuously updated with live data from IoT devices and AI systems, enabling real-time monitoring, simulation, and optimization (Owusu-Berko, 2025); (Ivanov et al., 2019). When augmented by AI, digital twins can replay past events, test alternative scenarios, and forecast future states with exceptional precision, effectively bridging the gap between the physical and digital worlds (Enrique et al., 2024); (Chen, 2024). The integration of simulation, AI, and blockchain within these systems strengthens supply chain resilience, refines inventory management, and enforces end-to-end quality control (Prajapati, 2025); (Adeyinka et al., 2022).

Over time, these waves have shifted the focus of digital transformation from efficiency and cost control toward agility, resilience, and quality improvement. The evolution from ERP systems to digital twins shows how digitalization has grown from an operational tool into a strategic meta-capability that underpins competitive advantage in a volatile environment.

3. Digitalization and Supply Chain Performance Dimensions

Across all five dimensions (cost efficiency, agility and resilience, quality improvement, ESG performance, and integration) digitalization consistently enhances both operational and strategic outcomes. However, the extent of these benefits depends on how well firms integrate digital resources, develop adaptive routines, and manage information flows. The following section synthesizes these findings and discusses how the combined application of RBV, DCT, and IPT offers a unified theoretical explanation of digitalization's impact on supply-chain performance and production quality.

3.1 Cost Efficiency

Improving cost efficiency has long been one of the most visible goals of supply-chain digitalization. However, digital efficiency does not simply come from automation or cost cutting; it emerges from the ability to use data intelligently to eliminate waste and optimize decisions. RBV suggests that efficiency gains arise when firms deploy digital assets that are valuable, rare, and difficult to imitate. Examples include proprietary AI forecasting algorithms, blockchain-secured transaction ledgers, and customized IoT sensor networks, which are technologies that rivals cannot easily reproduce (Wang & Prajogo, 2024; Lima et al., 2025). Once integrated into supply chain routines, these resources help firms cut waste, use assets more effectively, and lower transaction and coordination costs, creating efficiency gains that competitors struggle to imitate.

Yet efficiency is never static, as DCT highlight, it requires constant renewal. Digitalized supply chains enable this renewal by making real-time monitoring, predictive maintenance, and flexible redeployment of materials, labor, and other inputs possible whenever demand shifts or disruptions occur (Yu et al., 2024; Salamah et al., 2023). Firms that can spot inefficiencies early, capture opportunities for improvement, and adjust operations are better able to keep savings even when conditions are unstable.

Information Processing Theory shifts the focus to how organizations cope with information demands under uncertainty. When data are timely, reliable, and tied to the context, firms can cut through uncertainty and decide faster (Oliveira et al., 2024; Hirna, 2025). As Korpela et al. (2021) note, blockchain reduces conflicts and avoids intermediaries by securing transaction records. Similarly, IoT analytics identify potential issues early, allowing firms to act before disruptions become expensive (Boyson et al., 2021).

3.2 Agility and Resilience

Agility and resilience are now seen together in many supply chain studies. Agility is about quick reactions and flexible adjustments, while resilience refers to absorbing shocks and keeping operations stable (Nagy & Szentesi, 2025). Combined, they show how supply chains can bounce back from disruptions and even improve afterward. From an RBV these traits matter strategically because they draw on digital tools and resources that rivals find hard to imitate. this includes AI forecasting, blockchain for visibility, and digital twins, which allow firms to making digital systems a lasting source of advantage (García Reyes & Avilés González, 2021)

Dynamic Capabilities Theory, which explains how firms adapt resources over time, adds another layer. It shows that agility and resilience are not fixed traits but the result of sensing change, acting on opportunities, and reorganizing resources (Nweze, 2024). Digitalization speeds up this process. Real-time data integration allows firms to test disruption scenarios before they happen, while digital platforms make it easier to shift resources quickly when shocks occur. This was clear during the COVID-19 pandemic, when firms with strong digital systems were able to adjust production and logistics much faster than others (Jum'a et al., 2025); (Gomes & Silva, 2025). in this way Agility and resilience can be viewed as continuous processes that evolve alongside the digital maturity of firms.

Information Processing Theory suggest that under high uncertainty, organizations need relevant information flows (Tan, 2023). Tools such as blockchain-based traceability, IoT sensors, and AI-driven analytics make this possible by detecting weak signals of disruption early, giving firms more time to prepare and apply contingency measures (Wang et al., 2025; Abourokbah et al., 2023).

Recent studies show that agility and resilience not only complement each other but also reinforce one another. Agility allows firms to respond quickly, but without resilience these responses may create instability or rising costs. Resilience, in turn, ensures that agile actions remain balanced and sustainable (Sharma et al., 2024). Digital transformation deepens this interplay, particularly when it is combined with organizational innovation and strong absorptive capacity. Firms that draw lessons from past disruptions and embed them into future practices display the most adaptive performance (Dubey et al., 2023).

3.3 Quality Improvement

Improving quality in digitalized supply chains does not happen automatically through automation. It depends on how advanced technologies are deliberately integrated into production and logistics. When firms use these tools strategically, they can lower defect rates, improve product consistency, and build stronger customer trust, linking operational efficiency with long-term competitiveness. From the Resource-Based View (RBV), quality leadership appears when companies apply digital resources that are rare, difficult to copy, and embedded in daily routines. Examples include AI-driven inspection systems, blockchain-based tracking of product origins, and IoT-enabled monitoring of production conditions. Their strategic value comes not only from the technology itself but also from the way these tools become part of everyday practices, generating learning effects and operational know-how that rivals cannot easily imitate (Nagy & Szentesi, 2025; Danandjojo et al., 2024).

Dynamic Capabilities Theory reframes quality improvement as an ongoing process of sensing quality risks, seizing innovation opportunities, and reconfiguring operational processes accordingly. Digital tools such as predictive analytics, digital twins, and automated defect detection allow firms to not only respond rapidly to quality issues but also anticipate and prevent them before they manifest (Giovanni, 2020), (Maas et al., 2023). By enabling continuous feedback loops and rapid reallocation of resources toward quality-critical tasks, digitalization turns quality management into a dynamic, adaptive capability.

Information Processing Theory clarifies how digitalization improves quality by enhancing the volume, accuracy, and timeliness of information flows across the supply chain. Real-time data sharing reduces delays in detecting deviations, while AI-enhanced analytics pinpoint root causes more quickly and precisely than manual methods (Barla, 2024), (Wang, 2024). Blockchain-based traceability systems eliminate disputes over quality responsibility, and IoT-driven monitoring ensures that products meet standards throughout the logistics chain (Salhab et al., 2023), (Giovanni, 2020).

Empirical studies reinforce this integrated perspective. Evidence from both manufacturing and service supply chains shows that digitalization leads to tangible quality improvements, including lower defect rates, stronger compliance with customer requirements, and enhanced brand reputation (Fish, 2011; Nowicka, 2020). However, these benefits are not simply the result of introducing new technologies in isolation. Research highlights that digital investments produce greater quality gains when combined with supply chain integration, cross-functional collaboration, and continuous learning. Such organizational enablers allow firms to share knowledge more effectively, align operational objectives, and adapt quickly to emerging challenges, thereby amplifying the value created by digital tools (Xu et al., 2023; Peng et al., 2023).

3.4 ESG and Sustainability

Digitalization in supply chains is widely recognized as an important driver of Environmental, Social, and Governance (ESG) performance. It links operational efficiency with long-term sustainability goals. Under the Resource-Based View tools such as blockchain traceability, AI-based carbon accounting, and real-time environmental monitoring are valuable and difficult to imitate (Chen et al., 2024). They give firms a strategic advantage by ensuring environmental compliance, improving oversight of labor practices, and increasing transparency across supply networks (Tian et al., 2024). Complementing this perspective, Oubrahim and Sefiani (2024) propose an integrated multi-criteria decision-making approach to evaluate sustainable supply-chain performance in manufacturing. Their findings highlight that environmental and social indicators must be incorporated into performance frameworks, reinforcing the multi-dimensional nature of supply-chain evaluation in digitalized contexts.

From Dynamic Capabilities Theory perspective ESG performance viewed as the result of continuous adaptation

(Singh et al., 2024). It suggests that firms must be able to detect risks, respond quickly to opportunities for green innovation, and adjust operations to meet new requirements. Digitalization supports this process by linking logistics with renewable energy, promoting circular economy practices, and automating ESG reporting (Wei, 2025). Such adaptive capacities are particularly valuable in contexts where regulations, stakeholder expectations, and social risks change rapidly (Tsoulfas, 2024).

Information Processing Theory shifts attention to data management. In this view, industry 4.0 technologies can increase the accuracy and speed of ESG reporting, while blockchain secures the integrity of information (Radi et al., 2024; Onukwulu et al., 2025). Together, these systems reduce information gaps, strengthen trust with stakeholders, and guide investment and procurement decisions toward sustainability goals (Wang & Zhang, 2024; Cheng, 2025

Empirical studies confirm these benefits. Firms that adopt digital tools often influence their suppliers to improve ESG outcomes by encouraging innovation, collaboration, and closer supervision (Gao & Wang, 2025; Ye & Dong, 2024). Other research highlights the role of fintech, showing how automated compliance checks, supplier risk prediction, and sustainability-linked financing support ESG integration (Bin, 2025).

3.5 Integration and Collaboration

Finaly we can also say digitalization is transforming how supply chains integrate and collaborate. Instead of focusing on transactional exchanges, firms are increasingly building long-term partnerships based on real-time data sharing, joint decision-making, and the creation of mutual value. From the Resource-Based View (RBV), integration capabilities such as blockchain-based interoperability, cloud-enabled collaboration platforms, and IoT-supported production visibility qualify as rare, valuable, and difficult-to-replicate resources. By embedding transparency, trust, and coordination into day-to-day operations, these technologies strengthen competitiveness and deepen inter-organizational relationships [(Zdziarska & Marhita, 2019); (Bautista-Santos et al., 2015).Firms that go further, developing proprietary collaborative algorithms, secure partner-specific APIs, or predictive integration models, create unique resource configurations that are even harder for competitors to replicate, thereby gaining sustained strategic advantage (Bhagat & Kim, 2019).

Under the Dynamic Capabilities Theory, integration is not a static state but a continuous process of reconfiguring inter-firm linkages to remain aligned with evolving market dynamics, regulatory shifts, and technological advancements (Najat & Eddine, 2024; Ge, 2024). Digital tools facilitate this adaptability by enabling integrated planning, synchronized production scheduling, and adaptive logistics coordination. In practice, such capabilities allow supply chain partners to respond collectively to disruptions, seize emerging opportunities, and co-develop innovative solutions (Lu et al., 2021; Chen & Tang, 2024). The benefits are magnified when integration spans strategic, tactical, and operational levels, supporting joint resource reallocation, collaborative market entry strategies, and coordinated service delivery.

From the standpoint of Information Processing Theory , supply chain integration improves performance by enriching the quality, timeliness, and accuracy of information exchanged among partners. Stronger information flows reduce uncertainty and allow decision-making processes to be better aligned across organizational boundaries, which in turn enhances the collective ability of firms to act cohesively in fast-changing environments [(Neubert et al., 2004); (Hetterscheid & Beißert, 2018)]. Cloud-based platforms and service-oriented architectures now provide the technical infrastructure for such integration, connecting otherwise isolated enterprise systems and enabling synchronized forecasting, collaborative demand planning, and coordinated inventory control (Xu et al., 2004; Mai, 2021)].

Empirical studies support this theoretical view, showing that higher levels of integration, expressed through shared granular data, distributed decision-making authority, and joint performance metrics, have a direct positive effect on agility, resilience, and service quality (Mushaluk & Chen, 2014; Garcia et al., 2023). Integration also generates sustainability benefits. By improving traceability, verifying ethical sourcing, and enabling real-time compliance monitoring, digital collaboration strengthens ESG performance (Pessot et al., 2019). In this sense, integration plays a dual role: driving operational excellence while also reinforcing social and environmental accountability.

4. Critical Analysis and Theoretical Synthesis

Digitalization has evolved from being a set of isolated technologies to becoming a central driver of organizational competitiveness. Yet, the literature often treats digitalization either as a resource to be acquired, a capability to be developed, or an information system to be optimized. This paper argues that digitalization should instead be understood as a meta-capability—a higher-order capacity that integrates technological, organizational, and informational competencies to generate sustainable performance and quality improvements across the supply chain.

The thematic review above shows that digitalization brings measurable benefits to supply chains. These include cost savings, greater agility and resilience, better quality control, stronger ESG outcomes, and improved collaboration. However, the research base remains fragmented. Many studies still examine outcomes in isolation, either by looking at single indicators or by focusing on one industry. This narrow focus makes it harder to see the broader links between digitalization, operational performance, and production quality (Soto-Silva et al., 2024; Gao & Wang, 2025.) As a result, progress toward a comprehensive explanatory model has been slow.

Theory development has followed a similar path, have each been used to explain aspects of digitalization, but rarely together in a single framework. RBV-based studies often underline the strategic role of scarce digital resources but give less attention to the adaptive processes highlighted in DCT (Chen & Tang, 2024). Research rooted in DCT tends to emphasize agility and resilience, whiique resource advantages described by RBV. IPT-focused work contributes valuable insights into how firms manage information flows, but usually pays little attention to strategic resource building or dynamic adaptation (Nweze, 2024). Because of this lack of integration, our understanding of how digitalization supports lasting improvements in performance and quality is still incomplete.

A further limitation concerns the scope of empirical work. Sector-specific studies in manufacturing, logistics, agri-food, and healthcare have generated valuable operational insights, but cross-industry comparisons remain scarce (Tian et al., 2024; Tsoulfas, 2024). This restricts the generalizability of findings and makes it difficult to identify universal patterns, context-dependent contingencies, or trade-offs associated with digital transformation. Without a broader comparative lens, opportunities to refine and test theoretical models across diverse market, technological, and environmental contexts remain underexploited.

4.1. Identified Gaps in the Literature

A critical examination of the current body of work reveals three interrelated categories of gaps—conceptual, methodological, and contextual—that constrain the development of a unified understanding of the link between digitalization, supply chain performance, and production quality.

From a conceptual standpoint, the literature often isolates digitalization's effects on single performance dimensions, such as cost efficiency or resilience, without addressing their interdependencies. For example, while some studies highlight digital tools' role in enhancing agility, they neglect to examine how these same tools simultaneously influence quality management or ESG compliance (Nagy & Szentesi, 2025, Radi et al., 2024). Moreover, despite the complementary nature of RBV, DCT, and IPT, integrated theoretical models are rare, resulting in fragmented explanations of how digital resources are deployed, adapted, and operationalized into actionable intelligence (Chen & Tang, 2024).

Methodologically, the field is dominated by case studies and cross-sectional surveys, often focused on single industries or geographic regions (Tian et al., 2024). This reliance on limited-scope designs restricts causal inference and fails to capture the longitudinal dynamics of capability development and performance transformation. Few studies employ multi-level or mixed-method approaches capable of linking firm-level digital capability building with network-level performance outcomes (Soto-Silva et al., 2024). Additionally, performance measurement remains inconsistent, with metrics for "quality" and "resilience" varying widely between studies, undermining comparability and synthesis (Gao & Wang, 2025).

Contextually, there is a bias toward large, technologically advanced firms, with limited attention paid to small- and medium-sized enterprises (SMEs) and firms operating in emerging markets (Tsoulfas, 2024). These underrepresented contexts may exhibit different digitalization pathways, capability configurations, and performance trade-offs. Likewise, cross-industry comparative studies are scarce, which hampers the ability to generalize best practices or identify industry-specific constraints (Wei, 2025). Finally, while sustainability is increasingly linked to digitalization, few studies explore its simultaneous interaction with operational quality and cost efficiency, missing an opportunity to conceptualize supply chain performance in holistic terms (Singh et al., 2024).

4.2 Contradictions in the Literature

While there is broad agreement that digitalization can enhance supply chain performance and quality, the literature presents several contradictory findings that complicate theory building and managerial guidance. One source of divergence concerns the scale of performance gains. Some studies report substantial cost reductions, agility improvements, and defect rate decreases following digital transformation (Yu et al., 2024), whereas others find only marginal improvements or context-dependent benefits, especially when digital investments are not matched with organizational change and capability development (Gomes & Silva, 2025).

A second area of contradiction lies in the relationship between digitalization and resilience. While certain studies position digital tools as unequivocal enablers of resilience through enhanced visibility and rapid response mechanisms (Tan, 2023), others caution that overreliance on digital systems may introduce new vulnerabilities such as cybersecurity risks, data dependency, and technological rigidity, that can undermine resilience in crisis scenarios (Sharma et al., 2024).

Quality improvement outcomes in the literature also exhibit notable inconsistencies. While several studies associate IoT-enabled process monitoring and AI-based quality inspections with tangible reductions in defect rates (Maas et al., 2023), other research emphasizes that digital technologies alone are insufficient without complementary human capabilities, such as skilled operator training, effective cross-functional collaboration, and a culture of continuous improvement (Barla, 2024). In some cases, digitalization may even foster a false sense of process control, leading to managerial complacency and the masking of latent quality issues that remain undetected until they cause significant disruptions (Giovanni, 2020).

Similarly, the ESG-related effects of digitalization are subject to varying interpretations. Technologies such as blockchain-based traceability systems and AI-driven sustainability analytics are often praised for their capacity to enhance transparency, accountability, and regulatory compliance (Chen et al., 2024). Yet, a growing body of research points to important caveats. Several studies warn that digitalization, despite its benefits, can also create negative side effects. Data-heavy operations often raise energy use, and the quick replacement of digital tools adds to electronic waste. Smaller suppliers may also face exclusion if they cannot afford the resources needed to meet new technology requirements (Radi et al., 2024). These issues suggest that while digitalization can improve areas such as carbon monitoring and emissions reduction, it may at the same time create challenges for social inclusion and long-term environmental sustainability.

5. Implications

The findings of this review carry implications at three levels: theoretical, managerial, and societal.

5.1 Theoretical Implications

The main theoretical contribution of this review lies in demonstrating how RBV, DCT, and IPT complement one another when applied to digitalization. Rather than treating these perspectives as competing, future work should emphasize their integration. As Bigliardi (2022) observes, digital technologies generate advantage only when firms combine unique resources with the routines that make them usable. This implies that RBV alone is insufficient unless connected with dynamic adaptation and enhanced information flows.

Viewing digitalization as a meta-capability provides a way forward. XiaoWen (2025) shows that even firms with similar digital tools achieve different outcomes depending on their absorptive capacity and ability to learn from partners. This supports the idea that digitalization should be conceptualized as a higher-order capability that cuts across levels of analysis: individual resources, organizational routines, and network relationships.

Finally, integrative frameworks must also capture the paradoxical effects of digitalization. Jam (2025) highlights that while digital tools strengthen collaboration and resilience, they may also create dependencies and exclude less capable partners. Theoretical models therefore need to explain not only how digitalization creates value but also how it redistributes risks and power across supply networks. By synthesizing RBV, DCT, and IPT in this way, scholars can move beyond fragmented explanations and develop richer accounts of how digitalization shapes supply chain performance and production quality.

5.2 Managerial Implications

For practitioners, the review highlights that digital transformation must be approached as an enterprise-wide strategy rather than a collection of isolated technology adoptions. Real performance gains in agility, resilience, and quality arise when digital investments are tied to governance frameworks, change management initiatives, and employee training (Praveenadevi et al., 2023).

Managers face two persistent challenges: integrating old and new systems, and ensuring the quality and security of data flows. Many organizations continue to rely on legacy ERP platforms while adopting newer tools such as AI analytics or blockchain. The real test is not acquiring technologies but integrating them into coherent systems that deliver reliable, real-time information for decision-making (Rogetzer et al., 2018).

Equally important is balancing efficiency with sustainability. Overemphasis on short-term cost reduction can undermine environmental or social performance, while integration of ESG metrics into digital supply chains allows firms to achieve competitiveness and responsibility simultaneously (Lemoun et al., 2024). Digital tools also enable greater transparency, ethical sourcing verification, and stakeholder trust, which in turn become sources of reputational advantage (Shashi, 2022).

5.3 Societal Implications

At the societal level, digitalization of supply chains has the potential to advance sustainability goals by reducing carbon emissions, supporting circular economy practices, and strengthening accountability for labor and environmental standards (Čuček et al., 2024). Enhanced transparency empowers consumers and civil society to hold firms accountable, reinforcing democratic oversight of corporate behavior.

Yet the benefits of digitalization are unevenly distributed. Without deliberate intervention, advanced digital tools may widen the gap between large firms and SMEs, or between developed and emerging economies. Smaller suppliers risk exclusion if they cannot meet the technological demands of digitalized networks (Lemoun et al., 2024). Policymakers and international organizations thus have a role to play in ensuring equitable access, setting interoperability standards, and supporting resource-constrained firms through capacity-building and infrastructure investment (Liu et al., 2024).

In this sense, digitalization should be viewed not only as a managerial or technological issue but also as a societal project. Its long-term impact depends on whether efficiency and competitiveness are balanced with inclusiveness and sustainability.

6. Conclusion and Future Research Directions

Digitalization has become a defining feature of modern supply chains, shaping how firms create, deliver, and sustain value. This paper proposed that digitalization should be viewed not merely as a set of technologies, but as a meta-capability—a higher-order capacity that integrates digital resources, dynamic routines, and information-processing systems to enhance supply-chain performance and production quality (Wang & Prajogo, 2024; Mohaghegh et al., 2024; Jum'a et al., 2025).

By combining the Resource-Based View, Dynamic Capabilities Theory, and Information Processing Theory, the study offers a comprehensive theoretical framework explaining how digitalization operates across cost efficiency, agility, quality, sustainability, and collaboration (Panichakarn et al., 2024; Abourokbah et al., 2023).

Limitations and Future Research Directions

Although this study is conceptual, it opens several avenues for future empirical exploration. Researchers could test the proposed framework using Partial Least Squares Structural Equation Modeling (PLS-SEM) to validate the relationships between digitalization, dynamic capabilities, and performance outcomes (Jum'a et al., 2025; Abourokbah et al., 2023).

Another promising direction is cross-sectoral comparison. While this framework focuses on supply chain and production contexts, future research could extend it to service industries, public administration, or circular economy systems to assess its generalizability (Wang & Zhang, 2024), (Panichakarn et al., 2025).

Moreover, researchers should explore the human and cultural dimensions of digitalization. Leadership style, employee learning, and organizational mindset are likely to influence how digital capabilities are developed and sustained (Ghrbeia & Alzubi, 2024), (Nopriadi Saputra, 2024).

Finally, future work could investigate emerging technologies—such as quantum computing, edge AI, or decentralized autonomous organizations—and their potential to redefine information processing and organizational learning (Wang & Zhang, 2024), (Zighan et al., 2025). Looking ahead, future research could operationalize the meta-capability view of digitalization through detailed measurement scales and test the proposed framework across different industries and institutional settings. Longitudinal and cross-country studies would also help capture how digital capabilities, supply-chain performance, and production quality co-evolve over time. Further work might explore how emerging technologies such as edge AI, digital twins, and blockchain-based governance reshape the boundaries of digitalization as a meta-capability.

Final Reflection

In summary, digitalization represents more than technological progress; it reflects a transformation in how organizations think, decide, and act (Grilec Kauric et al., 2014), (Mohaghegh et al., 2024). By integrating resources, dynamic capabilities, and information systems, firms can build adaptive and resilient supply chains capable of sustaining performance and quality in turbulent environments.

Viewing digitalization as a meta-capability helps scholars and managers alike understand its systemic nature and its ability to connect technology, knowledge, and strategy into a continuous cycle of improvement (Vo Thai et al., 2024), (Saputra, 2024).

As organizations navigate an era of volatility, the challenge is no longer whether to digitalize, but how to orchestrate digitalization as an evolving capability that unites efficiency, innovation, and sustainability (Ning & Yao, 2023), (Zekhnini et al., 2021). This paper contributes a theoretical foundation for that journey and invites future research to refine, test, and extend the integrative framework presented here.

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