

The Impact of Enterprise Artificial Intelligence on Supply Chain Resilience

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Abstract

As the strategic technology leading the current times of technological revolution and industrial transformation, artificial intelligence is also one of the core promoters in high-quality supply chain development and has played an essential role in encouraging supply chains to switch to low-carbon and environmentally friendly models. Against this background, the authors try to explain how AI facilitates supply chain resilience through information transparency and dynamic capabilities, considering the moderating role of human capital competency. This conceptual paper findings suggests that corporate artificial intelligence has a significant impact on supply chain resilience; in this process, information transparency, innovative capacity, and absorptive capacity partially mediate these effects, and human capital competency positively moderates them. The paper provides new insights into the relationship between enterprise artificial intelligence and supply chain resilience from the perspective of its impact and underlying mechanisms and offers an important pathway for leveraging digital technologies toward sustainable supply chains.

Keywords: Artificial Intelligence; Supply chain resilience; Information transparency; Dynamic capability; Human capital competency

1. Introduction

Currently, the world is going through the wave of increasing uncertainty, which brings both opportunities and challenges with it. Black swan and grey rhino events are becoming increasingly common and are giving new dynamic possibilities of disturbing supply chains, thus creating new challenges in maintaining security and stability supply chains (Lin & Zhang, 2025). Between \$6 to \$10 billion cost a week were lost during 2021 blockage of the Suez and knocked 0.4% off annual

trade growth. In 2022, the war between Russia and Ukraine disrupted the supply of key components for cars, forcing the main vehicle manufacturers in Germany to stop assembling or partially stop production in several plants (Negi, 2026). Judging by those events, it was predictable for the United States and 13 other countries to sign the first-ever international supply chain agreement in 2023, which underlined how critical supply chain resilience has become to national policy and corporate competitiveness (Lin & Zhang, 2025). Within this context, effective ways and strategies will be studied to increase supply chain resilience to ensure the security of the supply chain. This paper argues that AI technologies can provide options and theories for practical sustainable development concerning improved supply chain resilience to unforeseen global shocks.

Early conceptual discussions regarding supply chain resilience have been associated with its definition. For example, Soni et al. (2014) proposed that supply chain resilience is a system's order to continue its status of normal, or even extraordinary, operation through various internal and external pressures. On the other hand, Brusset (2016) described supply chain resilience as the ability of a supply chain to withstand, and recover from, disruptions and disturbances. Shi et al. (2025) advanced beyond one possible approach to resilience in decomposing it into proactive, reactive, and design capabilities, thus providing a benchmark for subsequent research. Due to the complex hierarchical nature of the supply chain and the deeply involved entities forming them, most complex social and systemic hypothesis characterize supply chains. For instance, the recent high-velocity, uncertain, complex, and uncertain environments usually present high-security risk scenarios where weaknesses anywhere in the chain leave a lasting effect through the entire network. Under these conditions, digital technologies are fast becoming an important factor in overcoming such weaknesses. Researchers under these circumstances insist that modern digital technologies increasingly build supply chain resilience. Digitization thus leads to faster reaction times concerning changing market demands and increased firms' agility in production planning and control (Siagian et al., 2021). This allows further enhancement of the coordination of supply chain partners by upgrading the circulation of resources within networks through digital platforms and improving joint management performance in decision-making by partners in the supply chain upstream and downstream (Bag et al., 2020). Blockchain technology enables data sharing within the supply chain and asset holders encourage supply chain resilience through transparency and

visibility of operations (Ceptureanu et al., 2025). As a new, emerging strategic digital technology, artificial intelligence is identified as one critical future direction for managing supply chain risks while building resilience (Baryannis et al., 2018). Of all technologies, artificial intelligence is possibly the most influential in supply chain resilience (Shi et al., 2025). As part of the industry 4.0 initiative, AI facilitates the integration of critical areas such as supply chain network management and knowledge resource management (Zamani et al., 2023), gradually throughout all dimensions of supply chain operations and driving the adaptation and evolution of information systems (Ralston & Blackhurst, 2020). Throughout this process, AI take advantage of its information processing power to strengthen supply chain resilience (Belhadi et al., 2024), enhancing proactive and reactive resilience (Yue et al., 2025) and promoting the evolution of resilience from adaptive to sustainable and transformative forms. Artificial intelligence enhances supply chain resilience on multiple levels by reducing dependency, improving continuity, and boosting efficiency (Tang et al., 2025). However, while AI reinforces supply chain resilience, it also introduces challenges such as job displacement, privacy, and security risks, as well as ethical concerns (Beta et al., 2025).

The influence of AI on supply chain resilience in different industry characteristics, stages of the enterprise life cycle, and roles within the supply chain have been elaborated. Such elaboration has emerged from our analysis as part of how the internal and external context conditions the adoption of AI within organizations. Therefore, it enriches our understanding of how AI interacts with supply chain resilience. This research aims to contribute to theoretical modelling connecting AI with supply chain resilience and to provide empirical insights that can inform policymaking, thereby supporting the development of AI-driven sustainable supply chains.

The pattern of this paper is as follows: Section 2 states the research hypotheses logically derived from the above discussions. Section 3 gives an overview of variable selection, data sources, and the development of the econometric model. Section 4 discusses the empirical results and their due validity checks. Finally, Section 5 discusses the implications of the findings and suggests some policy options.

2. Literature Review

2.1. Enterprise Artificial Intelligence and Supply Chain Resilience

Artificial intelligence (AI) has unique advantages over other techniques. It facilitates penetration, substitution, and innovation, thereby enhancing collaboration across different parts of the supply chain. It supports industries by providing them with operational support, flexible networks, and intelligent economic activities. Therefore, it provides smoothly functioning supply chain and diverse value generation. The processing and sharing of information capabilities supports building supply chains resilience through AI (Fosso Wamba & Akter, 2019).

In every segment of the supply chain, AI plays the leading role in providing data support that is required for both the identification and reduction of risks. Therefore, this forms the basis upon which traditional supply chains will be ecologically networked. The rise of this network would involve collaboration between cross-border entities in economic activities by using smart platforms to form partnerships among global actors through enhanced information flow and improved cooperative efficiencies in the information processing of the value chain (Sahaym et al., 2023). This proves that AI enhances collaboration across the supply chain. Artificial intelligence may take over labour intensive functions in manufacturing and cause a "machine-replacing-human" effect in labor demand within companies (Liu et al., 2025). Thus, so far, intelligent systems have automated the tedious parts of production, pushing it even further toward automation and intelligence.

AI certainly can assess the worth of alternative solutions while tracking the best-expected outcomes (Paschen et al., 2019). For example, in inventory management, AI-based customer profiling minimizes warehousing costs and reduces surplus stock, and stockouts. It also allows companies to develop intelligent logistics systems to offer real-time updates on the status of transportation to connect production and consumption points efficiently and effectively. AI in marketing gives better marketing outcomes for organizations as it improves the entire process of product, pricing, promotion, and channel (Shi et al., 2025). For products, it reduces development and testing time, provides state-of-the-art product design, and enhances overall productivity (Cooper, 2024). While for pricing, smart algorithms are developed for providing accurate

consumer profiles that enable dynamic and personalized pricing (Chen et al., 2024; Trusov et al., 2016). As far as promotion is concerned, marketing intelligence explains consumer preferences which leads to excellent copywriting and targeted content creation (Li et al., 2024; Goli & Singh, 2024).

As for channels, AI opens new and dynamic ways to link upstream and downstream enterprises. In pattern recognition and real-time decision-making, the capabilities of interactive technologies make them fit for increasing customer engagement and loyalty in downstream enterprises (Chatterjee et al., 2021). It also allows companies to pass information across different industries and stages to allow collaboration in all parts of the supply chain and boost overall resilience. The following research hypothesis was formulated based on such an analysis:

Hypothesis 1: Enterprise artificial intelligence can enhance supply chain resilience.

2.2. The Mediating Role of Information Transparency on Enterprise Artificial Intelligence and Supply Chain Resilience

Information transparency refers to the capacity of all supply chain participants to share and jointly make decisions in a properly structured environment. It involves full data visibility, enhanced trust, and full collaboration—all vital ingredients of resilience in a supply chain context. In this sense, smart technologies further advance the speed of information flow among business units and eliminate distortion and misrepresentation of such information. Smart technologies equally manage and optimize supply chains while facilitating data sharing throughout the supply chain (Helo & Hao, 2021). More exposure to data probably gives less temptation for management to exploit asymmetrical information in conducting any noncompliant business. Hence, because less opportunistic behavior and lower transactional uncertainty tend to increase trust among supply chain partners, this will also build resilience in the supply chain. Different aspects of transparency concerning management practices and market performance visible to outsiders are where artificial intelligence technologies pay enormous attention; that embedding effect on transparency, in combination, is not insignificant.

The outside marketplace can view a firm operating in this environment in real-time with phenomenal clarity. Hence, the barriers that both the upstream and downstream supply chain

players face start to disappear. This allows firms to embed a communication structure in their organizations that facilitate quick information flow through the supply chain, thereby minimizing knowledge gaps within the firm. For instance, according to Toorajipour et al. (2021), sharing information with suppliers and manufacturers mitigated the bullwhip effect and, thus, maintained equilibrium in the supply and resources. Such clarity promotes interaction in the supply chain network between upstream and downstream players and provides a firm with the ability to resource allocation plans quickly in the supply chain based on any change in demand. In this regard, a firm can real-time shift resources, increase its capacity for collaboration, and enhance the supply chain robustness. Therefore, the following research hypothesis is proposed:

Hypothesis 2: Information transparency plays an intermediary role between artificial intelligence and supply chain resilience.

2.3. The Mediating Role of Dynamic Capabilities on Enterprise Artificial Intelligence and Supply Chain Resilience

Dynamic capabilities are crucial in building supply chain resilience and holding firms continued competitive advantages through uncertainty. As Wang and Ahmed (2007) suggested, dynamic capabilities comprise three critical components: innovation capability, absorption capability, and adaptability. The innovation capability refers to an organization's ability to develop new products, enter new markets, and align its resources with the needs of the marketplace. On the other hand, absorption capability is defined as the organization's ability to identify, absorb, transform, and apply knowledge in generating solutions to identified problems. Adaption concerns change in internal factors such as organizational structure to align with changes in the external environment. Being a new digital technology, artificial intelligence can enhance supply chain resilience through the three pillars mentioned above.

Artificial intelligence specifically enhances information absorption and integration capabilities. It provides input for innovation at the corporate level and thus integrated resource capabilities toward the leverage of technology and knowledge. Apart from the type of innovation regarding technology, process, and organization, technological innovation empowers firms to detect risks at an early stage through technical means to develop suitable countermeasures. This significantly

increases the shock scarcity capacity of the supply chain. Process innovation gives firms agility; the capability of product and service adjustment in response to market demand shifts tends to be quite fast, which eliminates or minimizes supply-demand imbalances. Organizational innovation increases collaboration among supply chain members, thus increasing their collaboration and resilience. In a digital context, artificial intelligence might help in both the timeliness and accuracy of external knowledge acquisition. It extends the boundary of knowledge and increases the efficiency of knowledge processing, which enhances knowledge absorption capacity. Knowledge absorption capacity enables a firm to transform external knowledge into internal competencies more efficiently, thus allowing it to sense changes in market demand and adjust business strategies rapidly to avoid potential risks.

More importantly, absorption capacity enables firms to learn from crises, convert such lessons into successful innovation strategies, foster technological synergy throughout the supply chain, and enhance stability (Abourokbah et al., 2023). Furthermore, AI uses real-time data and intelligent market demand analysis to help companies overcome the delays that characterize traditional decision-making processes. Responses can then be speedy to changes in demand, policy disruptions, or any other external triggering factors, thus further enhancing adaptability. Adaptability, in turn, refers to the variable that defines the ability of a firm or organization to adjust in a timely manner operational planning to the rapidly floating currents of industry trends, technical innovations, and market shifts. It optimizes production input, minimizes cost, and keeps adequate reserve capacity to maintain service levels in case of interruptions in supply chain management.

Hypothesis 3a: Innovation ability plays an intermediary role between artificial intelligence and supply chain resilience.

Hypothesis 3b: Absorptive capacity plays a mediating role between artificial intelligence and supply chain resilience.

Hypothesis 3c: Adaptability plays a mediating role between artificial intelligence and supply chain resilience.

2.4. The Moderating Role of Human Capital Competence on Enterprise Artificial Intelligence and Supply Chain Resilience

Artificial Intelligence has become a core tool to enhance supply chains' resilience through improved processing and predictive analytics toward decision-making (Dubey et al., 2019). However, the application and deployment of AI in organizations depends on employees' capability. Human capital competence, as argued, is the totality of knowledge, skills, experiences, and problem-solving capabilities that help an employee integrate, manage, and optimize technologies such as AI (Del Giudice et al., 2021). AI can advance in automation, thus indirectly influence data-driven insights and real-time decision-making but not influencing supply chain resilience uniformly across organizations. As human capital competence denotes, it is an important measure of determining what happens after using AI in predicting possible disruptions and designing cushioning strategies for continuity in the supply chain (Kache & Seuring, 2017). A highly developed workforce interprets AI output and utilizes the insight emerging therefrom in an ethical and strategic manner by connecting technological opportunities to their practical usage (Centobelli et al., 2020).

Within this context, therefore, human capital competence will serve as a moderating variable that specifies the degree and direction of the association between enterprise AI and supply chain resilience. For example, enterprises endowed with more human capital assume a good position to leverage sophisticated analytical capabilities provided by AI, as evidenced by high performance along the dimensions of flexibility, speed, and strength during uncertainty (Dubey et al., 2019). However, with less human capital, it will be almost impossible to leverage enterprise AI and derive its full contribution to resilience. This is where human capital competence sees enterprise AI's contribution to achieving SC resilience among those firms with a talent pool of vast digital knowledge (Del Giudice et al., 2021; Barney, 1991). This agrees with the RBV view and argues that human capital is the only relevant resource that can create superior value from technological assets (Barney, 1991). Therefore, this reasoning supports the following research hypothesis:

Hypothesis 4: Human Capital Competence positively moderates the relationship between Enterprise Artificial Intelligence and Supply Chain Resilience

For all these reasons, this paper has brought forward information transparency, dynamic capabilities, and digital governance, building up the structural framework of enterprise artificial intelligence and supply chain resilience, as depicted in Figure 1:

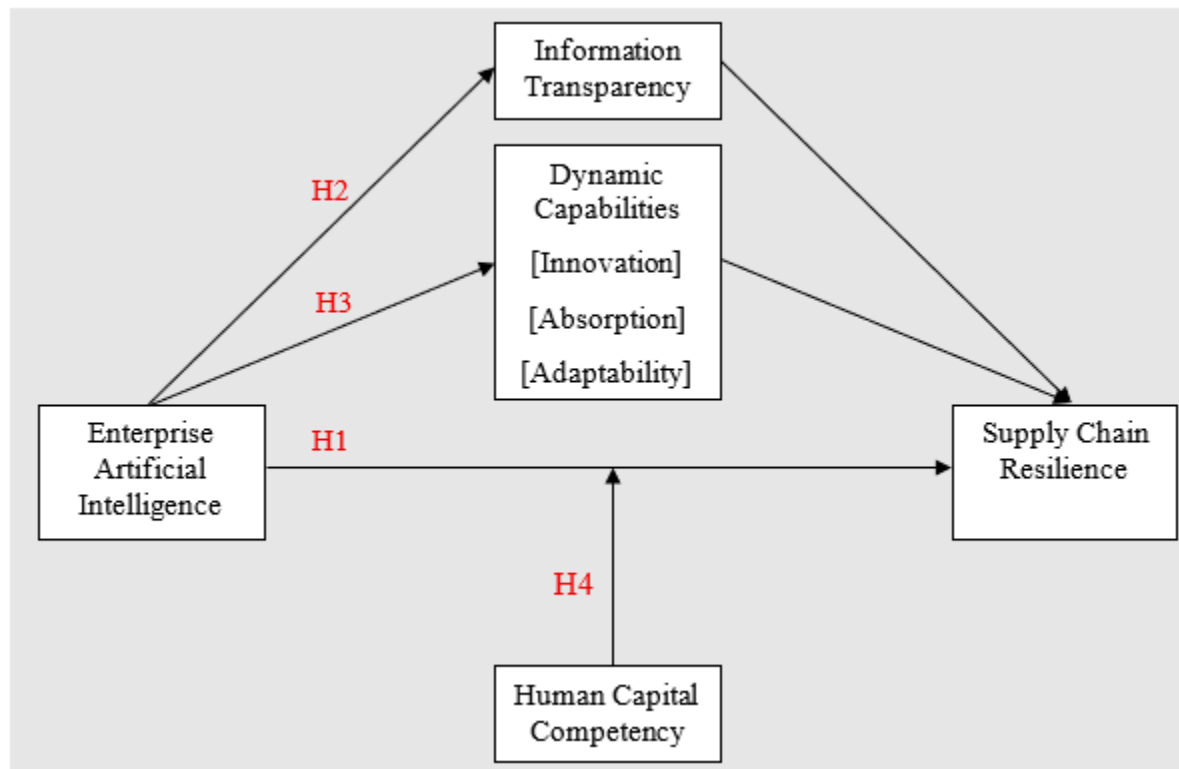


Figure 1. Theoretical Framework

3. Research Methodology

This paper is conceptual, comprising the mediating role of information transparency and dynamic capabilities between Enterprise Artificial Intelligence and Supply Chain Resilience, with Human Capital Competency moderating the degree of resilience. The conceptualization of these relationships is that artificial intelligence underpins the drivers within SC in building resilience, and yet, as evidenced, the efficacy again depends on the organization-made human capital and governance practices and digital capabilities conditions. This is because IT and dynamic capability will be able to provide appropriate contingency plans in implementing AI within SC.

Most previous literature has discussed these variables, with much consideration on the separated effect of either AI or the other component, information transparency, dynamic capability, or human capital- towards the performance of supply chain. Several studies have examined how these factors interact, whether conflicting or complementary, contributing to resilient supply chains, particularly in the post-2025 era (Lin & Zhang, 2025; Shi et al., 2025). Particularly important amongst such

advanced applications has been analysis of interaction effects amongst these variables within the special case of industrial context by companies listed in Pakistan. The need for context-based reasoning has thus been set out.

Given these interactions, the present model is grounded in Dynamic Capabilities Theory and thus can reflect the relationship of AI, information transparency, and dynamic capabilities towards the building of supply chain resilience. Data and theoretical insights for this conceptual study shall be collected from several secondary data sources, mainly from academic databases such as Google Scholar, ScienceDirect, and Scopus.

4. Discussion and Conclusion

This study supports significant roles of AI in increasing the resilience of supply chains, with information transparency, innovation capability, and absorptive capacity as partial mediators. In this regard, digital governance indeed represents a positively moderating variable. Further analysis has revealed that the facilitating effects of AI are more pronounced within high-tech firms, manufacturing companies, those at the growth stage and mature stage, and chain masters.

These findings strongly align with dynamic capability theory, revealing that AI, as a strategic digital asset, will develop the resilience of the supply chain against disruptions. Supporting the previous studies of Wang (2022) and Xu Y et al. (2025) this study further pushes the theoretical frontiers by detailing how information transparency, dynamic capabilities, and digital governance engage in a mechanism at play. Information transparency acts as a mediator, whereby AI technology enhances visibility across supply chains by integrating diversified data sources through intelligent algorithms in a transparent information environment. This, in turn, allows the AI systems to engage in accurate demand forecasting, optimized holistic decision-making, and efficient cross-chain coordination systematically, thus improving supply chains in preventing, withstanding, and recovering from disruptions.

Therefore, the role of innovation and absorption capacity argues that with intelligent analytical capabilities, AI will enhance firms' ability to perceive and adapt to supply chain risks, thus enabling fast responses to disruptions. In parallel, the generative technologies behind AI instigate organizational innovation by creating new solutions that cause a need for structural optimization

and even paradigm shifts in the supply chain. In summary, all these actions systematically convert technological advantages of AI into long-term resilience benefits, as supported by Le (2024). Digital government, in this respect, adds another institutional environment variable since the provision of open data resources and the construction of cross-border digital infrastructure provide computational support for enterprise AI systems. Further, the digital regulation and the governance platforms developed to support collaborative governance reduce policy uncertainty associated with AI applications. Such changes improve enterprise AI application scenarios and make enterprise translating AI into supply chain resilience advantages easier. Consequently, AI plays a more significant role in the supply chain resilience development process.

In summary, this indicates that artificial intelligence is contributing to supply chain resilience not as a standalone technological solution but through complex internal mechanism- external institutional support interactions of which an effective expression ultimately results in diverse corporate environments.

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