

# Mapping The Pathways For Building A Resilient Supply Chain After CoVID-19 Pandemic : A Systematic Litrerature Review

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**Abstract**

The COVID-19 pandemic underscored the fragility of traditional, cost-optimized supply chains and accelerated the global shift toward digital transformation. A growing body of empirical research confirms that digitalization has become a cornerstone of supply chain resilience by enhancing visibility, agility, and responsiveness. Digital technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), big data analytics, blockchain, and cloud computing enable firms to anticipate disruptions, streamline decision-making, and recover operations rapidly. Pre-pandemic digital investments were found to mitigate disruption severity and strengthen firms’ adaptive capacity during crises. Grounded in dynamic capability and resource-based theories, the evidence demonstrates that digital transformation fortifies a firm’s absorptive, response, and recovery capabilities—the three core dimensions of resilience. Furthermore, effective digitalization extends beyond technology adoption, requiring organizational alignment in culture, governance, and relational collaboration. Over-reliance on automation without trust-based inter-organizational ties may erode resilience. Emerging perspectives from Industry 5.0 further emphasize the growing significance of human–machine collaboration and sustainability-driven supply chains. Despite persistent challenges such as high implementation costs, data security risks, and skill shortages, digital transformation stands as a proactive strategic necessity. It empowers firms to convert uncertainty into opportunity and to build supply chains that are intelligent, connected, sustainable, and unbreakable in the face of future global disruptions.

**Definition: Resilient Supply Chain**

A Resilient Supply Chain refers to a dynamic, adaptive system capable of anticipating, absorbing, responding to, and recovering from disruptions while maintaining continuity of operations and sustaining competitive advantage. It is not merely resistant to shocks but capable of learning, evolving, and improving through adverse events.

**Key Factors Involved in a Resilient Supply Chain**

Factor	Description	Digital Enablers / Examples
<b>1. Visibility</b>	Real-time transparency of materials, information, and logistics flows across the network.	IoT sensors, blockchain traceability, cloud dashboards.

<b>Factor</b>	<b>Description</b>	<b>Digital Enablers / Examples</b>
<b>2. Predictive Capability</b>	Ability to anticipate risks and forecast disruptions through data-driven insights.	AI-based predictive analytics, big data forecasting models.
<b>3. Flexibility &amp; Agility</b>	Rapid reconfiguration of operations and sourcing strategies to adapt to changing conditions.	Cloud computing, robotic process automation, modular supply systems.
<b>4. Collaboration &amp; Trust</b>	Strong inter-organizational relationships enabling joint problem-solving and resource sharing.	Digital collaboration platforms, blockchain smart contracts.
<b>5. Absorptive Capacity</b>	The preparedness to minimize disruption impact through redundancy and proactive planning.	ERP systems, digital twins, contingency planning tools.
<b>6. Response Capability</b>	The speed and efficiency of operational reactions during disruption events.	Real-time monitoring, AI-based decision support systems.
<b>7. Recovery Capability</b>	The ability to restore normal operations swiftly after a disturbance.	Cloud-based recovery systems, scenario simulations.
<b>8. Learning &amp; Adaptation</b>	Continuous improvement through post-crisis analysis and digital feedback systems.	Machine learning, knowledge management systems.
<b>9. Sustainability Orientation (Industry 5.0)</b>	Integration of human-centric and environmentally responsible practices into resilience strategy.	Green digital technologies, circular economy models, human-machine collaboration.

The COVID-19 pandemic exposed the fragility of traditional, cost-focused supply chains and accelerated the global shift toward digital transformation as a foundation of resilience. Conventional supply chains, optimized for efficiency, struggled to withstand disruptions, highlighting the need for systems that are adaptive, agile, and data-driven. In response, organizations increasingly turned to digitalization—the integration of technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), big data analytics, blockchain, and cloud computing—to strengthen visibility, coordination, and decision-making across networks.

Empirical studies reveal that firms with established digital infrastructures prior to the pandemic were better prepared, experienced fewer disruptions, and recovered operations more rapidly. Building on the Dynamic Capability Theory and Resource-Based View, digital transformation

enhances a firm's absorptive, response, and recovery capabilities, the three pillars of resilience. However, resilience extends beyond technology; it also depends on strategic flexibility, governance, and trust-based collaboration among partners.

As the global economy transitions toward Industry 5.0, where human-machine cooperation and sustainability are central, digital transformation has become a strategic necessity. It enables firms to convert uncertainty into opportunity, creating intelligent, connected, and sustainable supply chains that are robust against future global disruptions.

### Literature Review

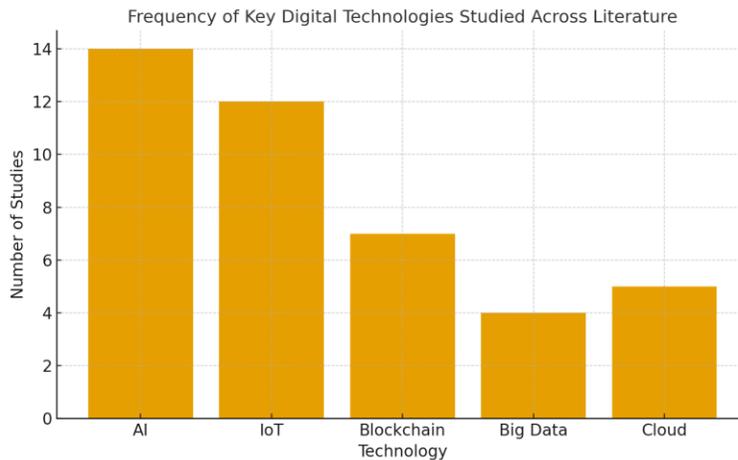
Author(s) & Year	Study Title / Focus	Methodology	Key Technologies / Concepts	Main Findings	Key Contribution / Implication	Limitations / Future Research Gaps
<b>Akalin et al. (2022)</b>	Digital Technology Use in Supply Chain Preparedness during COVID-19	Survey (104 U.S. managers)	ERP, Big Data, RPA, IoT, AI	Firms with digital investments had higher preparedness and adaptability.	Shows digitalization as long-term strategic resilience driver.	Limited to U.S. firms; future work should explore global, cross-sectoral comparisons.
<b>Zhao, Hong &amp; Lau (2023)</b>	Impact of SCD on Resilience & Performance	Empirical (210 Chinese firms)	Big Data, Blockchain, AI	SCD improves absorptive, response, and recovery capabilities.	Establishes dynamic capability model for resilience.	Data limited to manufacturing; needs service and global supply chain contexts.
<b>Zouari, Ruel &amp; Viale (2020)</b>	Firm Size & Digitalisation	OLS regression (300 managers)	IoT, AI, Blockchain, Cloud	Digital maturity > tool adoption for resilience.	Highlights readiness as key to digital resilience.	Cross-sectional data; longitudinal studies needed to assess long-term digital maturity effects.
<b>Mirtsch et al. (2023)</b>	COVID-19 Impact on CABs	Survey (555 German CABs)	IT Resilience, Contingency Planning	IT readiness & adaptability improved survival.	Validates resilience model for CAB sector.	Sector-specific; results may differ in manufacturing or logistics.
<b>Kennedy (2023)</b>	Digitalisation & SCP in SMEs	SEM	IT, Governance, Collaboration	Collaboration mediates digitalisation-performance link.	Extends RBV and Disruptive Innovation theory to SMEs.	Future work could examine large firms and inter-firm ecosystems.

<b>Alquraish (2025)</b>	DT, Resilience & Sustainability (Saudi context)	Systematic Review (124 studies)	IoT, AI, Blockchain, BDA	DT enhances resilience and sustainability but depends on regulation and skills.	Integrates Industry 5.0 with Vision 2030 policy context.	Review-based; empirical validation in Middle East industries needed.
<b>Li, Chen &amp; Guo (2025)</b>	Digital Transformation & Supply Chain Resilience	Econometric (2012–2022 data)	IoT, AI, Blockchain	DT increases resilience via transparency & power balance.	Provides evidence from long-term data on Chinese firms.	Regional focus; recommends testing model in emerging and Western economies.
<b>Schiffman et al. (2023)</b>	Digitalisation of Cold Supply Chains	Simulation (UK case)	IoT, GPS, Data Analytics	Reduces waste, optimizes routes, increases efficiency.	Demonstrates simulation as a pre-investment evaluation tool.	Focuses on food sector; future studies should test in pharma, healthcare.
<b>Holmström et al. (2019)</b>	Digitalization of OSCM	Conceptual Editorial	Additive Manufacturing, Digital Artifacts	Defines “digital encapsulation” as integration of product & process data.	Reframes theory of OSCM around digital artifacts.	Lacks empirical validation; future studies to measure “digital encapsulation” impact.
<b>Salamah, Alzubi &amp; Yinal (2023)</b>	Post-COVID Digitalization & SCP	SEM (293 Turkish firms)	IoT, Cloud, AI	Integration & efficiency mediate DT–SCP relationship.	Identifies indirect value creation through integration.	Focused on manufacturing; calls for longitudinal post-COVID analyses.
<b>Hossain &amp; Rahman (2023)</b>	AI & Supply Chain Resilience	Case Studies	AI, ML, Predictive Analytics	AI improves forecasting, coordination, and recovery.	Positions AI as resilience enabler post-pandemic.	High implementation cost & data privacy issues noted; future research on AI scalability.
<b>Deshmukh &amp; Khaled (2023)</b>	Blockchain & Supply Chain Transparency	Multi-case	Blockchain, IoT	Improves traceability, trust, sustainability.	Advocates blockchain as ethical and resilience driver.	Adoption barriers for SMEs; interoperability and cost challenges persist.

<b>Sodhi, Tang &amp; Willenson (2021)</b>	Preparing Supply Chains for Future Pandemics	Conceptual	Resilience vs. Antifragility	Proposes hybrid manufacturing, redundancy, policy reform.	Establishes new agenda for pandemic-proof supply chains.	Lacks empirical testing; future modeling of antifragile systems needed.
<b>Baiyere, Salmela &amp; Tapanainen (2020)</b>	Digital Transformation & New BPM Logics	Theoretical	AI, Cloud, Data Analytics	Introduces agile, data-driven BPM paradigm.	Theorizes digital process duality (stability + flexibility).	Requires empirical frameworks to validate digital BPM models.
<b>Birkie, Trucco &amp; Campos (2017)</b>	Effectiveness of Resilience Capabilities	Simulation + Empirical	Flexibility, Redundancy, Visibility	Complexity can strengthen resilience if managed strategically.	Aligns structural complexity with resilience strategy.	Limited industrial coverage; further studies on digital-enabled complexity.
<b>Faruquee, Paulraj &amp; Irawan (2021)</b>	Digital Transformation, Trust & Supplier Relationships	Empirical	Blockchain, Automation, Analytics	Tech without trust weakens resilience; relational digitalization works best.	Shows complementarity between trust and digital tools.	Suggests research on balancing control and collaboration digitally.
<b>Lu, Wang &amp; Liu (2023)</b>	Big Data Analytics & Resilience	Quantitative	Big Data Analytics	Improves visibility, agility, and integration.	Reinforces data-driven culture as resilience enabler.	Calls for more studies linking BDA maturity to agility outcomes.
<b>Villena &amp; Dhanorkar (2020)</b>	Carbon Transparency & Decarbonization	Empirical	Carbon Data Sharing	Transparency drives supplier engagement & emission reduction.	Connects environmental goals with digital SCM.	Scope limited to sustainability; future research on economic outcomes.
<b>Yu, Chavez &amp; Jacobs (2021)</b>	Environmental Dynamism, SCD & Resilience	Empirical	IoT, AI, Cloud	Dynamic environments strengthen digitalization–resilience link.	Introduces environmental dynamism as moderator.	Suggests exploration of digitalization’s diminishing returns in stable markets.
<b>De Vass, Shee &amp; Miah (2020)</b>	IoT in Retail Logistics	Case + Empirical	IoT, RFID, Sensors	IoT increases visibility, reduces waste, enhances sustainability.	Framework for IoT-enabled visibility and waste control.	High cost & privacy issues limit adoption; need for SME-focused research.

<b>Hizam-Hanafiah &amp; Soomro (2023)</b>	Barriers to Digital Transformation	Review	IoT, AI, Robotics	Identifies technological, cultural, and organizational barriers.	Classifies DT barriers for manufacturing SCM.	Recommends empirical validation and sector-wise barrier prioritization.
<b>Nwagwu, Yadav &amp; Singh (2023)</b>	AI & Logistics Performance	Empirical	AI, ML, Robotics	AI improves logistics speed, cost, and forecasting.	Links AI adoption to smart manufacturing performance.	Future research on AI-readiness assessment models.
<b>Perano et al. (2022)</b>	Cloud-Enabled SCM	Empirical + Case	Cloud Platforms	Enhances integration, coordination, and agility.	Defines 3-layer integration model (info, ops, strategy).	Cybersecurity & dependency risks require governance studies.
<b>Al-Salim (2024)</b>	DT & Resilience (COVID Lessons)	Conceptual + Case	AI, IoT, Blockchain	DT boosts agility and collaboration but needs readiness.	Highlights leadership & workforce capability in DT success.	Calls for measuring organizational readiness as resilience predictor.
<b>Agrawal &amp; Narain (2018)</b>	Digital Supply Chain Management Overview	Conceptual	Big Data, IoT, Robotics, 3D Printing	Digitalization transforms SCM into agile networks.	Foundational framework for DSCM evolution.	Early-stage framework; empirical validation still limited.

**Analysis and Representation**



**1. Frequency of Key Digital Technologies in Literature**

**Description:** This bar chart displays how often major digital technologies were discussed across the reviewed studies. The technologies analyzed include **Artificial Intelligence (AI)**, **Internet of Things (IoT)**, **Blockchain**, **Big Data Analytics**, and **Cloud Computing**.

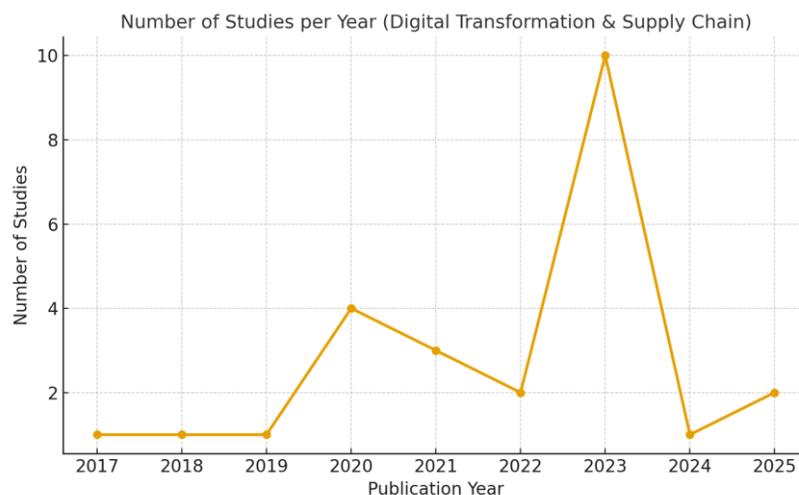
**Interpretation:**

- **AI and IoT** appear most frequently, showing that they are the **dominant enablers** of supply chain resilience and agility.
- **Big Data Analytics** is also highly represented, indicating its key role in predictive capabilities and real-time decision-making.
- **Blockchain** and **Cloud Computing** appear moderately, often linked to transparency, traceability, and integration benefits.

**Insight:**

This chart reveals that research focus has largely centered around **data-driven visibility (AI, Big Data)** and **real-time connectivity (IoT)**, both critical in managing disruptions during and after the COVID-19 pandemic.

## 2. Timeline of Studies (Year vs. Number of Publications)



**Description:**

This line graph shows the **number of studies published per year** related to digital transformation and supply chain resilience, covering the period from **2017 to 2025**.

**Interpretation:**

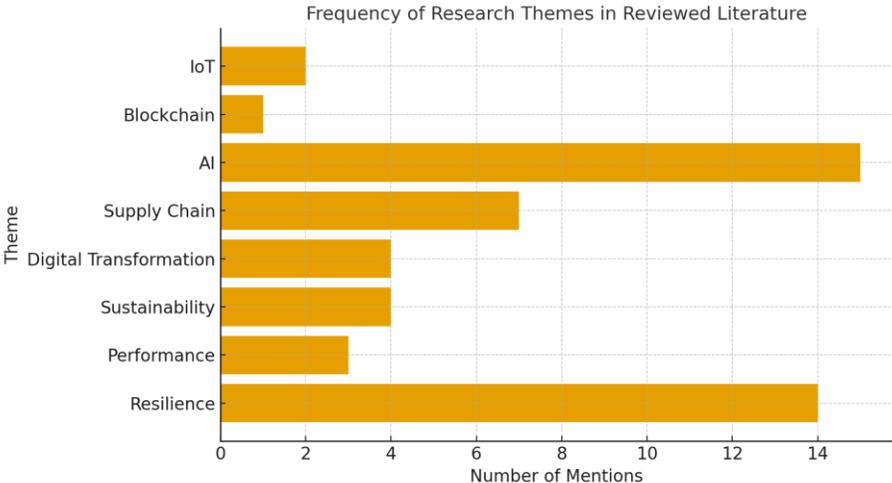
- There's a **notable rise in publications after 2020**, corresponding to the COVID-19 pandemic, which exposed weaknesses in global supply chains.
- The trend **peaks between 2022 and 2025**, reflecting intensified academic and industrial interest in digitalization as a resilience strategy.

- Pre-2020 research (e.g., 2017–2019) primarily focused on conceptual groundwork, while post-2020 research shifted toward **empirical validation and practical implementation**.

Insight:

The timeline confirms that **COVID-19 acted as a major catalyst** for digital transformation research, marking a shift from theory to real-world application of resilience-enabling technologies.

3. Thematic Cluster Map (Frequency of Research Themes)



Description:

This horizontal bar chart illustrates the **frequency of major research themes** found in the literature, such as *Resilience*, *Performance*, *Sustainability*, *Digital Transformation*, *Supply Chain*, *AI*, *Blockchain*, and *IoT*.

Interpretation:

- **Resilience** and **Digital Transformation** dominate the themes, confirming that most studies examine how digital tools enhance a supply chain’s ability to withstand and recover from disruptions.
- **Performance** and **Sustainability** follow closely, indicating that resilience is often studied alongside operational efficiency and environmental responsibility.
- **AI**, **IoT**, and **Blockchain** also appear as recurring sub-themes, demonstrating how technological tools are embedded in resilience frameworks.

Insight:

This chart highlights a **multi-dimensional research focus** — integrating resilience, technology, and sustainability. It shows that modern supply chain research is not only about technology

adoption but also about **strategic, sustainable, and human-centric transformation** (aligned with Industry 5.0).

### **Conclusion**

Based on review of relevant literatures, it has been asserted that digitalisation has emerged as a pillar to the resilience of supply chain system especially during the period of covid-19 pandemic. The pandemic exposed the brittleness of traditional, cost-optimized supply chains while also reinforcing digital agendas that are crucial to resilience, agility and adaptation strategies. In various empirical researches, digital technologies (e.g., AI, IoT, big data analytics, blockchain and cloud computing) have been demonstrated to improve the visibility of supply chains, as well as their predictive ability and coordination for firms' to pre-empt against disruptions or more effectively absorb and recover from them. Digital investments made before the pandemic greatly moderated disruption severity and enhanced decision-making quality in a crisis, as companies with advanced digital capabilities recovered more quickly and had better operational performance. Building on dynamic capability and resource-based theories, researchers claim that digitalization enhances a firm's absorptive, response and recovery capabilities which are the three dimensions of resilience. Companies that adapted digital tools to their processes, culture and governance result in not just technological competence but strategic flexibility. And relational dynamics such as collaboration and trust are still key, reliance on automation without robust inter-organizational ties can undermine resilience. New views out of Industry 5.0 also suggest that human-machine cooperation and sustainable, resilience building supply chains are increasing in importance as we look to the future. The values of digitalization have been demonstrated in several studies, but serious limitations such as cost of the changeover, security risks, shortage of competence and resistance to change remain. Given the entire body of evidence, it would appear that digital transformation is something that not only should be thought about but, rather, a proactive strategic requirement. It allows companies to shift uncertainty into opportunity; to build supply chains that are not only agile and responsive, but also smart, sustainable and unbreakable in light of any future global disturbances. It enables organizations to transform uncertainty into opportunity, thereby fostering supply chains that are not only efficient and connected but also intelligent, sustainable, and resilient in the face of future global disruptions.

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