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Evaluating the Empirical Effects of Automated Logistics Coordination on the Resilience of Humanitarian Supply Chain in Nigeria

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Abstract: *Humanitarian supply chains in Nigeria operate amid conflict, displacement and funding shortfalls, making resilience essential, yet empirical evidence on artificial intelligence-enabled logistics in Nigeria remains scarce. This study evaluates the empirical effects of automated logistics coordination (ALC) on humanitarian supply chain resilience, measured through visibility, collaboration and agility. Grounded in Socio-Technical Systems Theory, an explanatory, cross-sectional survey of humanitarian sector workers across Nigeria's six geopolitical zones was conducted using stratified random sampling. Multiple linear regression was applied to 258 usable responses (67.2% of the planned 384). ALC showed a small, positive effect on visibility (B = .143, p = .033) that was sensitive to model specification, but no significant effect on collaboration (B = .066) or agility (B = -.004). The findings support a phased, human-centric digital transformation that prioritises data quality, interoperability and governance before scaling automation, rather than treating technology alone as a resilience solution.*
Keywords: Automated logistics coordination, humanitarian supply chain resilience, visibility, collaboration, agility

INTRODUCTION

The present global humanitarian scenario is marked by an unparalleled rise and intricacy of crises. Approximately 305 million individuals worldwide will require urgent humanitarian aid in 2025 due to conflict and climate change, with food insecurity and displacement reaching critical levels (UNOCHA, 2025; Yahaya et al, 2025). Following the onset of the Russian incursion into Ukraine on 24 February 2022, the UK Parliament Research indicated in October 2025 that around 5.2 million individuals have emigrated from Ukraine, alongside an additional 3.8 million internally displaced within the country (Philip & Phillip, 2025). The humanitarian crisis in eastern Ukraine, which has persisted since 2014, has been exacerbated by the ongoing conflict. The humanitarian conditions in Gaza remain critical. The collapse of the health system, persistent conflict, and an 11-week cessation of aid delivery have led to an unparalleled rise in unmet medical and humanitarian needs. The British Red Cross (2025) reports that almost 1.5 million individuals currently require emergency accommodation.

The Gaza Strip, a small and densely populated region in the Middle East, has faced myriad challenges owing to years of conflict, political instability, and economic blockade (Faris et al, 2025). The extended blockade has significantly impaired agricultural output, devastated essential infrastructure, and limited access to fundamental supplies such as food, fuel, and water. It has also been accompanied by recurrent surges of aggression. As a result of these conditions, the populace relies on external aid for sustenance, leading to one of the greatest levels of food insecurity globally (Buheji & Hasan, 2024). The persistent strife in Gaza has affected 95% of its inhabitants, with more than 1 million individuals anticipated to encounter starvation by 2025. The incidence of acute malnutrition has escalated, particularly in children, with 30% of those in northern Gaza experiencing severe malnutrition. The devastation of infrastructure, encompassing water and sanitation systems, has deteriorated the circumstances, resulting in a rise in communicable diseases and further aggravating malnutrition (Waal, 2024; IPC, 2024; UNICEF, 2024; Hassoun et al, 2025).

In Africa, the persistent strife between Sudan's military and the Rapid Support Forces (RSF) has led to a civil war in the nation since April 2023. It has resulted in a famine and accusations of genocide in the western Darfur area, raising concerns for the inhabitants of el-Fasher following its capture by the RSF. The UN has referred to the situation as the "largest humanitarian crisis globally," with more than 150,000 fatalities resulting from the conflict, and over 12 million individuals displaced from their residences (Booty et al, 2025; Irfan et al, 2025). According to reports, about two-thirds of Sudan's populace (exceeding 30 million individuals) require some type of humanitarian aid, with more than 25 million experiencing severe hunger (Brown, 2025).

The United Nations Office for the Coordination of Humanitarian Affairs views the future of Sudan as grim, hence underscoring the necessity for humanitarian aid as vital (2025). The transfer of aid is frequently obstructed by both factions in the conflict, and over 70% of healthcare institutions in

war-impacted regions have suffered damage or destruction. As of July 2025, only 15% of Sudan's humanitarian financial requirements for 2025 had been met, suggesting that the global reaction to the crisis generated by this conflict has been inadequate (Kaur, 2025; Alexander et al, 2025; Fadul, 2025; Hemmeda, 2025).

As of 2025, Nigeria's humanitarian emergency impacts millions due to food scarcity, conflict, and additional issues; 8.8 million individuals in Northern Nigeria and 7.9 million in the Northeast require aid (ReliefWeb, 2025). Malnutrition constitutes a significant problem in Nigeria, with 30.6 million individuals facing food insecurity and 1.8 million children projected to endure severe acute malnutrition (Amnesty International, 2025). The humanitarian initiative is significantly lacking in financial support, notwithstanding the endeavors of organizations such as the Nigeria Humanitarian Fund (NHF) (Ifatimehin & Paul, 2024; Yahaya et al, 2025).

Unlike profit-oriented commercial supply networks, the humanitarian supply chain navigates profound uncertainty, notable unpredictability, and a solitary goal: to save lives and reduce suffering (Son et al, 2025). The circumstances for civilians have worsened in all the incidents cited earlier because international bodies like the United Nations and Red Cross, along with national organizations such as the National Emergency Management Agency (NEMA), are incapable of formulating a cohesive response and defining strategic aims. (Kaur, 2025). The humanitarian field is overwhelmed by multiple ongoing conflicts (such as those in Sudan, Gaza, and Ukraine), the rampant spread of deadly diseases (including the COVID-19 pandemic and the Ebola outbreak in Africa), and the escalating incidence of severe droughts resulting from the harmful impacts of climate change. This demand may detrimentally influence the long-term sustainability of humanitarian supply chains (Anjomshoae et al, 2025; Mazar et al, 2024; Rahman et al, 2025).

A humanitarian supply chain is formed by a temporary coalition of stakeholders focused on reducing the impact of an incident on those affected. Humanitarian supply networks strive to optimize the efficacy and efficiency of operations aimed at assisting persons requiring aid (Jayadi, 2025). Humanitarian operations are defined as large-scale and intricate efforts designed to mitigate the severe consequences of human distress resulting from catastrophic occurrences, notably natural disasters, armed conflicts, and worldwide health emergencies (pandemics). The unexpected dynamics of disasters, the multitude of stakeholders, site-specific operational necessities, and legal restrictions severely hinder humanitarian operations, affecting management (Hoang et al, 2024; Wahab et al, 2024).

While disasters may be inevitable, studies in disaster operations can substantially refine management and decision-making strategies, enhancing the effectiveness and efficiency of humanitarian supply chain performance (Ahmad et al, 2025). Within humanitarian supply chains, resilience signifies the capability to predict, prepare for, endure, avert, and sustain ongoing operations via mitigation, contingency planning, and preventive actions. The durability of humanitarian supply chains is crucial for the distribution of life-saving support, especially considering the growing prevalence and complexity of disasters in hostile geopolitical

environments. The durability of supply chains in humanitarian scenarios has proven crucial for successful relief and disaster response initiatives (Ahatsi & Olanrewaju, 2025a; Tay et al, 2025). Therefore, it stands as the crucial determinant in evaluating the performance of humanitarian endeavours (Singh, 2025a; Srivastava & Bag, 2025).

The extent of the humanitarian disaster in Nigeria, defined by millions of internally displaced people in need of persistent aid, calls for a significant change from reactive logistics to a forward-thinking and predictive methodology in supply chain management. This stipulation acts as the groundwork for examining creative alternatives (Modgil, 2025).

In humanitarian relief logistics, agility is of paramount importance. The agility of supply chains markedly improves the efficiency of service provision in humanitarian operations. Agile supply chains can respond more rapidly to unforeseen alterations, thus enhancing operational efficiency (Maagi, 2025; Yildiz & Biyikli, 2025). Given the unforeseen and sudden characteristics of several calamities, it is crucial for reaction mechanisms to be rapid, flexible, and inventive. As a result, humanitarian supply chains must be constructed to be both resilient and flexible. Agility is an essential element among other factors that affect the efficacy of humanitarian supply networks. It facilitates the swift distribution of aid supplies and services to individuals most impacted by humanitarian crises. The efficacy of humanitarian supply chain entities is evaluated based on their capacity to do thorough assessments to pinpoint the most affected communities and their operational agility (Mazar et al, 2024; Akhtar et al, 2025; Bamel, 2025).

Supply Chain Visibility, defined as an entity's ability to monitor and oversee each phase of the supply chain process instantaneously, constitutes another characteristic of a resilient supply chain. Supply chain visibility refers to the ability of stakeholders to obtain precise, comprehensive, and prompt information regarding the flow of resources and products within the supply chain (Zheng & Brintrup, 2025). Beyond only providing operational advantages, supply chain visibility serves as a crucial strategic resource that empowers organizations to make better informed decisions. Enhanced visibility fosters improved operational efficiency, risk mitigation, and agility by augmenting process transparency, ultimately contributing to sustained corporate performance (Liu et al, 2025; AlMahri et al, 2026).

In humanitarian supply chains, composed of numerous interrelated entities, collaboration is crucial. In this context, collaboration encompasses all entities engaged in the movement of commodities, services, information, and finances; this ranges from soliciting donations to delivering assistance and overseeing waste management. (Akinbamini et al., 2025; Mubarik et al., 2025). Humanitarian supply chains can leverage synergistic potential to generate revenue and foster sustainable development by collaboratively optimizing the entire value chain while also tackling operational challenges (Li et al., 2025b). Scholars assert that enhancing collaboration within supply chains is a viable remedy for the challenges faced by humanitarian organizations in executing their tasks. Collaborative supply chain paradigms, including shared services and interoperability frameworks, have garnered increased interest from global and humanitarian

entities as potential solutions to limitations that diminish the benefits of comprehensive visibility and economies of scale (Singh, 2025a; Kunz, 2026).

Artificial intelligence-driven methodologies can significantly enhance the capabilities of logistics operations by facilitating real-time coordination, optimizing resource distribution, and augmenting overall system efficiency. Traditional logistics systems are often structured for high-volume, low-diversity production methods, making it challenging to adapt to the increasing demand for swift responses in humanitarian supply chains. Moreover, these challenges could be exacerbated by insufficient real-time synchronization of information and material flows (Loganathan et al, 2026). Automated logistics coordination entails the mechanization, synchronization, and administration of supply chain operations, including transportation, inventory management, and warehousing, utilizing software, artificial intelligence, and robotics, devoid of human intervention. It lowers expenses, enhances efficiency throughout the logistics framework, and minimizes human mistakes via instantaneous workflow enhancement (Cortez-Clavo et al., 2025; Li et al., 2025c).

The objective of this study is the evaluate how automated logistics coordination impacts humanitarian supply chain Resilience in Nigeria. The study will try to:
a. examine the effects of Automated Logistics Coordination on the transparency of Humanitarian Supply Chains in Nigeria.;
b. assess the influence of Automated Logistics Coordination on collaboration within the Humanitarian Supply Chain in Nigeria.;
c. assess the influence of Automated Logistics Coordination on the agility of the Humanitarian Supply Chain in Nigeria.

LITERATURE/THEORETICAL UNDERPINNING

Conceptual Review

Automated Logistics Coordination

The increasing complexity of humanitarian crises has drawn more attention to the efficiency and adaptability of disaster relief supply chains and humanitarian logistics (Kurniawan, 2025). Automating logistics coordination in the humanitarian supply chain is a multifaceted procedure that combines several AI technologies to produce synergies that maximize logistics process operations. It entails using digital tools and artificial intelligence to organize, carry out, and continually monitor the transfer of humanitarian commodities with the least amount of human participation (Oliinyk et al, 2025; Cortez-Clavo et al, 2025).

Integrating different supply chain components allows for automated logistics coordination (Tiwari et al, 2024). Research indicates that automated logistics coordination can lower humanitarian operations' operational expenses. This is accomplished by substituting automated workflows for manual procedures (Kurniawan, 2025; Pantiris et al, 2025). According to studies, typical logistics operations are unable to efficiently anticipate, manage resources, and communicate in times of

crisis. A humanitarian supply chain's visibility and decision-making capabilities are greatly enhanced by automated logistics coordination (Tufa & Tebeka, 2025; Cortez-Clavo et al, 2025Studies show that standard logistical operations are incapable of effectively anticipating, managing resources, and communicating during emergencies. Automated logistics coordination significantly improves the visibility and decision-making capabilities of a humanitarian supply chain (Christhia et al, 2025).

Humanitarian Supply Chain

A humanitarian supply chain is the network, processes, and systems used to plan, procure, store, transport, and deliver essential aid like food, water, medicine, and shelter to people affected by natural disasters, pandemics, or conflicts. Its primary goals are efficiency, speed, and saving lives in challenging, often unpredictable situations, in contrast to commercial supply chains that put profit first. (Rutaba et al, 2025; Han & Jeong, 2025).

The humanitarian supply chain is essential for delivering relief during emergencies like pandemics, natural catastrophes, and wars. Its effectiveness and efficiency are hampered by a number of issues. The ability of these procedures to reduce the vulnerabilities of populations experiencing a crisis and offer prompt relief is a key indicator of their effectiveness (Sokat & Besiou, 2024; Gazi et al, 2025). According to disaster operations, the intricacy of the humanitarian supply chain continues to be a major global problem. This is especially true when it comes to the financial components of disaster response and relief operations, information flow, coordination, controls, and waste management (Dohale et al., 2024; Ahmadi et al., 2024; Rutaba et al, 2025). Humanitarian supply chains engage in last-mile delivery to recipients, warehouse management, quick procurement, and intricate logistics in regions with devastated infrastructure. The three primary stages of this are preparedness, response, and recovery (Thakur-Weigold, 2025).

Issues including unpredictable demand, infrastructure damage, and budgetary constraints affect humanitarian supply networks (Jayadi, 2025). The combination of artificial intelligence and human judgment enhances flexibility, resource distribution, and logistical efficiency. Cutting-edge technology, dependable infrastructure, and efficient communication systems are important enablers that allow seamless operations throughout the supply chain (Sultan et al, 2025).

Humanitarian Supply Chain Resilience

In order to maintain stability in humanitarian operations, resilience is defined as the capacity of participants in the humanitarian supply chain to foresee, postpone, and recover from interruptions. Scholars claim that enhancing flexibility, redundancy, collaboration, and agility can lead to resilience (Asgari, 2025; Ahatsi & Olanrewaju, 2025). Since 2024, supply chain resilience has prioritized sustainability and proactivity, with a focus on Industry 5.0 (Wei et al., 2026). Increasing resilience in a humanitarian supply chain requires the integration of artificial intelligence. Early warning systems, Real-time monitoring, Logistics optimization, and time series forecasting as key Artificial Intelligence techniques that improve resilience in humanitarian supply chains (Riad et al, 2024; Ahatsi & Olanrewaju, 2025).

The ability of a network to be strong and flexible, enabling it to react to and recover from catastrophic occurrences, is known as resilience in humanitarian supply chains. Resilience is built on sustainability. Humanitarian supply chains cannot sustain long-term operational profitability or successfully handle the unpredictable nature of pandemics and natural disasters without sustainable methods (Kashav & Garg, 2025; Hughes et al, 2025; Wang et al, 2025). Utilizing technology to create resilient supply networks is thought to be very beneficial for both commercial and humanitarian supply systems. By applying and researching new ideas, businesses may strengthen supply chain resilience and withstand disruptions (Dura et al, 2026).

Artificial intelligence, the industrial internet of things, robots, big data, augmented reality, blockchain, virtual reality, digital twins, and cloud computing are the eight enabling technologies that can improve resilience. Resilience is sometimes hampered in disaster-prone areas by problems with data quality, a lack of technological expertise, high processing costs, and infrastructure limitations (such as poor network connection) despite the availability of solutions (Ahatsi & Olanrewaju, 2025).

Humanitarian Supply Chain Collaboration

Supply Chain Collaboration is essentially predicated on the notion that companies should work together throughout the supply chain to achieve shared benefits that are not achievable through independent operations. According to Mubarik et al. (2025), this cooperation in the humanitarian context encompasses all the organizations engaged in the flow of goods, services, information, and money, from soliciting donations to distributing aid and disposing of waste. Supply chains can benefit from synergistic opportunities to create value and foster sustainable growth through cooperative optimization across the value chain in addition to resolving operational problems (Li et al, 2025b).

In humanitarian supply chains, which are made up of many interdependent parties, cooperation is essential. To guaranty that relief or rescue supplies reach those in need while upholding strict safety, quality, and regulatory compliance standards, these parties must collaborate closely. In humanitarian supply chains, where delays, misunderstandings, or a lack of transparency can result in fatalities, effective teamwork is especially crucial (Akinbamini et al, 2025). According to current research, transparency, trust, and shared goals are essential elements of successful teamwork (Mehmood et al, 2025; Mubarik et al, 2025; Weisz et al, 2025).

Transparency allows information to flow freely, which improves coordination and reduces uncertainty. On the other hand, trust enables long-term collaborations and encourages the sharing of risks and rewards (Mubarik et al, 2025). Strategic, operational, and technological cooperation are all aspects of supply chain cooperation. Coordinated production planning, shared logistics, inventory management, and other cooperative duties are all part of operational collaboration. Strategic partnership includes long-term investments, joint product development, and plans for mutually beneficial market expansion. Information system integration, blockchain technology for

transparency, and artificial intelligence for predictive analytics are all highly valued aspects of technological collaboration. While not exclusive, these dimensions are related (Mubarik et al., 2025; Weisz et al., 2025).

Humanitarian Supply Chain Visibility

Supply Chain Visibility is the capacity of businesses to track and observe every stage of the supply chain process in real time. Using social media marketing, businesses can increase their ability to identify disturbances, predict shifts in demand, and optimize logistics procedures (Bennett, 2025). Supply chain visibility is the capacity of stakeholders to access accurate, thorough, and timely information on the movement of goods and materials along the supply chain (Zheng & Brintrup, 2025b). The degree to which an organization's internal systems, partners, and external sources provide precise, timely, comprehensive, and functionally prepared data is known as supply chain visibility. Market visibility, supply visibility and demand visibility are the three categories of supply chain visibility (Li et al., 2025a).

The digitization of supply chain operations, which allows businesses to integrate several data sources and improve their responsiveness to market dynamics, has further strengthened visibility competency. Resilience can be achieved through the supply chain's visibility, cloud computing and information system interoperability, digitalization and technology like blockchain, and the promotion of strategies along the prepositioning of inventories and logistical readiness (Li et al, 2025a; Mirzaei et al, 2025; Sarioguz, 2025).

There are numerous advantages to supply chain visibility, but there are also numerous disadvantages. Data availability is a major hurdle because businesses are often reluctant to disclose private information due to competitive pressures and strict data privacy rules like the Nigerian Data Protection Act of 2023 (AlMahri et al, 2026). Furthermore, data heterogeneity makes integration efforts more challenging because supply chain data differs significantly in style, quality, and granularity across numerous enterprises and countries. Global supply chain coordination is further complicated by security concerns and regulatory constraints that impede cross-border information sharing (Delgado et al., 2025; Zheng & Brintrup, 2025b).

Some of the current methods for enhancing supply chain visibility include the use of RFID, cloud computing, blockchain, and enterprise resource planning (ERP) systems. These systems offer end-to-end visibility by gathering and sharing data across the supply chain network (Mirzaei et al, 2025). With increased supply chain awareness, managers and operators can lower risks, increase operational performance, and ensure regulatory compliance (Zhang et al., 2025c).

Humanitarian Supply Chain Agility

In order for a humanitarian supply chain to become resilient, supply chain agility is essential (Pereira and Shafique, 2024). To maintain a competitive edge and guaranty business continuity, organizations must implement strategic initiatives that increase their long-term sustainability and adaptability. Reducing risks, improving operational effectiveness, and fostering long-term growth

all depend on supply chain agility (Ahmad & Khokar, 2024). Agility in the context of the humanitarian supply chain is the ability to swiftly modify plans and actions to meet changing needs. Humanitarian Supply Chain Agility has the potential to significantly reduce response times and provide the capacity to swiftly alter the operating structure, according to Modgil (2025). Agility must be integrated with other operational and strategic humanitarian logistics factors, such as cost and long-term sustainability, using a more complex framework (Singh, 2025b).

According to the dynamic capability hypothesis, businesses can gain a competitive advantage by improving their competences. Artificial intelligence is essential for boosting supply chain agility because it enables companies to process data faster and improve situational awareness (Stanescu et al., 2025). Agility ensures operational stability even in the face of shocks, allowing businesses to quickly adjust to changes in the market. Supply chain agility, which enhances a company's capacity to identify and respond to threats, is crucial to supply chain resilience, or the ability to recover from unanticipated disruptions while maintaining continuity and efficiency (Primadasa et al, 2025).

The supply chain's agility gives it the vital dynamic ability that represents adaptive intelligence by monitoring signals from numerous marketplaces and sensing signs to react quickly to shocks in commercial settings (Al-Zoubi & Ramayah, 2025). Human capital resources and organizational external resources are considered essential strategies for achieving supply chain agility. More specifically, the agility of cash and voucher assistance programs may depend on how quickly the local market and supply chain respond to sudden changes in the demand expressed by affected persons (Maghsoudi et al., 2025).

Conceptual Framework

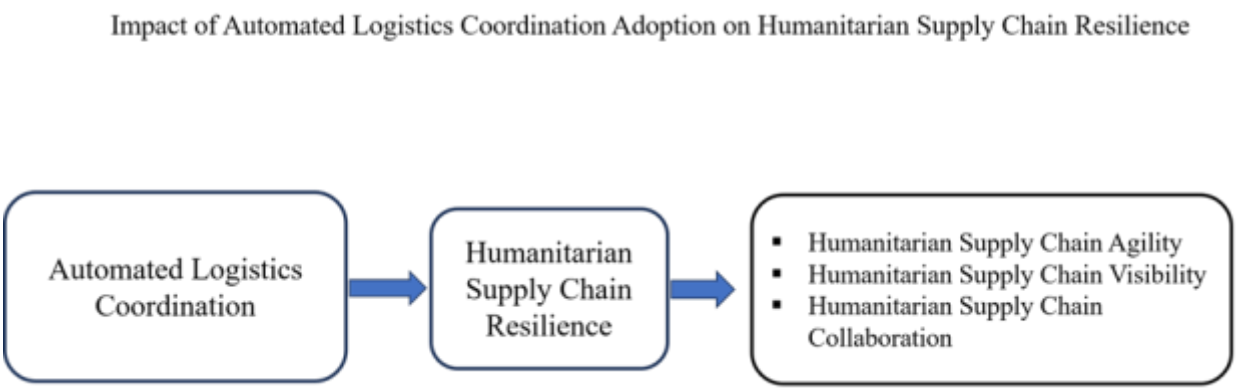


Figure 2.1: Relationship between Automated Logistics Coordination Adoption and Humanitarian Supply Chain Resilience Researchers Concept (2026)

Theoretical Review

Because Socio-Technical Systems Theory is applicable to the research being done, this study adopts it as its theoretical framework. The socio-technical systems framework helps developers create reliable and efficient solutions by bridging traditional systems and artificial intelligence-enhanced processes (Ang et al, 2025). This study views resilience as the result of interactions between technical, social, institutional, and environmental factors using the socio-technical systems lens.

The socio-technical approach is a perspective on organizations that focuses on how the organization's social and technological subsystems interact with one another and with its environment. The theory holds that organizations are made up of people who use technology to provide goods or services, and each of them has an effect on how the technology works, whether it is acceptable, and how the people who use it behave. This definition includes the value-added idea, which asserts that consumers who are a part of the organization's external environment value the goods and services produced. (Griffith & Dougherty, 2001; Subedi et al, 2025).

Open systems theory and generic systems theory are the foundations of socio-technical theory. As a result, it inherited ideas, traits, and presumptions from these theories. In order to reach a steady state in which the system as a whole and its constituent parts remain constant, the ideas of responsiveness to environmental influences, particularly the concept of equifinality (Abbas & Michael, 2025). This implies that outside factors will affect the system's performance, therefore managing complex circumstances requires an awareness of the connections between psychological, economic, technical, cultural, and political elements (Mumford, 2006).

The socio-technical theory uses the concept of a subsystem—the social, technical, and environmental—to differentiate between different aspects of a given system. Human elements are the focus of the social subsystem. The relationships, values, work-related components, structure, and associations that are provided by organizational members comprise the social subsystem of an organization (Abbas & Michael, 2025). When applied to an organizational setting, the technical subsystem refers to the physical and material flows within a transformation process as well as the tasks, control, and maintenance functions. It also refers to the tools, techniques, skills, and devices that employees need in order to accomplish organizational goals and tasks (Hanafizadeh & Mehrasa, 2025). The context, surroundings, and circumstances in which the open socio-technical system functions and is situated—referring to both the internal and external environments—are referred to as the environmental subsystem (Abbas & Michael, 2025).

There are two main tenets of socio-technical theory. fit between an organization's social and technological components that leads to the system's ideal state. We refer to this as collaborative optimization. The second concerns how social and technical elements interact to determine the system's success (Abbas & Michael, 2025; Subedi et al, 2025). One of the disadvantages of the socio-technical theory is the potential for participation to have unforeseen consequences in circumstances where consensus cannot be reached, despite the fact that stakeholder consultation

and participation are considered crucial to the success of socio-technical design and the achievement of joint optimization. (Michael & Abbas, 2025). It has been determined that socio-technical design and ethics have limitations relating to implementation, power, and involvement (Mumford, 2006).

Empirical Review

Masoomi et al, (2025) investigated the difficulties that humanitarian supply systems face. It consists of resource limitations, strong dynamism, and uncertainty. The impact of Artificial Intelligence Facilitators on the performance metrics of the Supply Chain Operations Reference model in humanitarian supply chains was investigated in this study. Given the ongoing development of industry 4.0 and the expanding number of its applications, particularly the emergence and significance of artificial intelligence, artificial intelligence technologies could be revolutionary tools to enhance supply chain performance if their benefits complement supply chain operations while addressing problems in this domain. To find and extract artificial intelligence facilitators, a literature review was conducted. The interactions between facilitators were then examined using a SCOR model. The relationships between these facilitators were then modeled using a fuzzy cognitive map. Hebbian learning was used to do a sensitivity analysis. The study's findings showed that performance measures like agility, cost effectiveness, and dependability were positively correlated with predictive analytics, logistics optimization, and drones. The report also provides politicians, technological developers, and humanitarian groups with valuable insights by outlining a path for the application of artificial intelligence and resource efficiency.

Additionally, Ahatsi & Olanrewaju's (2025) study looked at the use of big data analytics and artificial intelligence to improve the resilience of humanitarian supply chains. South Africa and Ghana were the study's main subjects. The researchers found that adoption is low in emerging economies despite the potential advantages of big data analytics and artificial intelligence. A quantitative technique was used in an explanatory research design. 200 supply chain experts from both countries made up the sample size. Structured questionnaires were used to gather data. To find the connection between these tools and supply chain resilience, data analysis was done using regression analysis and exploratory factor analysis. The study concluded by suggesting capacity building initiatives, encouraging stakeholder management, and improving data quality to maximize the impact of AI and big data analytics. It also found that AI and big data analytics tools greatly increase the resilience of humanitarian supply chains.

A systematic literature study on digital transformation, agility, trust, and cooperation in humanitarian logistics was carried out by Yildiz and Biyikli, (2025). In addition to highlighting the importance of trust and institutional structures for technology-enabled collaboration, their synthesis shows that digitalization and information technologies can enhance information distribution, responsiveness, and coordination during disaster response. The study's significance to the current research is interpretive because it is a review rather than a primary-data inquiry; it does not offer direct evidence from national agencies, but it does support the anticipated mechanisms tying digital competence to resilience.

Nsama, (2025) explored a framework for supply chain resilience that is driven by artificial intelligence, designed to enhance autonomous decision-making, adaptation, and proactive responses during significant disturbances in the United States. The goal of this artificial intelligence framework was to boost situational awareness and expedite recovery through the use of predictive analytics, machine learning, and digital twins. The framework's effectiveness was evaluated through simulations involving shortages, cyberattacks, and a global transportation shutdown. The study assessed performance based on four criteria: inventory recovery time, service level, reduction in cost impact, and response time. The AI solution enhanced cost impact reduction by 35%, cut inventory recovery time by 6.67 days, raised service levels by 32.7 percentage points, and decreased mean response time by 45 hours. The results indicate how AI-enabled solutions can alter the development of supply chain resilience. The framework offers an extendable architecture ideal for new threats like AI-enabled cyberattacks and climate-driven disruptions, in addition to solving the real-time visibility and agility gaps of conventional systems. The study's conclusions offer a guidance for the creation, administration, and deployment of intelligent supply networks in important infrastructure areas.

In Kenya, Nyile (2025) evaluated the effect of supply chain efficiency on effectiveness of humanitarian aid groups. The researcher utilized a mixed-methods technique evaluating data from 330 humanitarian groups and qualitative comments from supply chain managers. Data evaluation was performed utilizing descriptive statistics, thematic content analysis, and regression analysis to examine the influence of supply chain efficiency on organizational performance. The research revealed that supply chain efficiency contributes to 43.6% of the variance in the performance of humanitarian organizations, and this percentage rises with the incorporation of organizational traits. The research qualitatively determined that cost optimization, internal controls, and waste reduction are crucial for enhancing efficiency. The study indicates that removing bottlenecks improves aid distribution in accordance with the theory of constraints. The results underscore the need of embracing lean management practices, investing in advanced supply chain technologies, and adjusting supply chain strategies to align with organizational characteristics. These actions can improve resource usage, accountability, and responsiveness, which will ultimately raise the effectiveness of humanitarian operations in crisis situations.

Younesse et al, (2025) performed a systematic literature study about the influence and function of artificial intelligence in supply chain management. The five-step procedure examined literature spanning 2000 to 2024 across many databases. A total of 426 papers were recognized in the review that concentrated on artificial intelligence methodologies. The research indicated that although artificial intelligence has the capacity to enhance supply chain management, issues such as inadequate infrastructure, a lack of experienced labour, and the need for effective change management must be tackled.

Sentia et al, (2025) aimed to pinpoint areas that are under-researched by scholars to delineate study deficiencies and propose suggestions. The hybrid literature review, which combines a systematic

literature review with thematic analysis, was conducted. The analysis pinpointed six areas requiring enhanced investigation within humanitarian supply chains. The utilization of information technology and information systems to enhance stakeholder coordination, decision-making facilitated by information technology and systems, logistics and inventory planning supported by information technology and systems, resolution of warehousing, routing, and delivery challenges through information technology and systems, and victim identification and evacuation assisted by information technology and systems. The academics contend that the study's results are significant as they serve as a framework for subsequent researchers.

Tufa and Tebeka (2025) focused on the management of humanitarian logistics in Ethiopia, intending to assess perceptions of these approaches, pinpoint critical challenges, and propose ways to improve healthcare access for recipients. The logistical challenges were examined through an explanatory and descriptive case study methodology. Simultaneously, a mixed methods strategy was employed, combining quantitative and qualitative data. Using a census sampling technique, the study surveyed 92 technical and managerial specialists from nine directorates engaged in important humanitarian logistical operations. Findings Twenty key concerns were detected in the study and divided into five areas. The results demonstrated that different organizations' approaches to handling humanitarian logistics varied greatly. Distribution management was the second most regularly used logistics function, after inventory management. Conversely, the execution of transportation and procurement management was subpar. Significant inefficiencies in the humanitarian logistics system are noted in the paper, especially in the areas of transportation and procurement management. The provision of medications to patients is delayed as a result of these inefficiencies, which interfere with humanitarian activities. Insufficient logistics may result in unnecessary costs, increased hardship, and loss of life.

In their 2024 research, Aryatwijuka et al. examined the role of localized logistical capacity in moderating the relationship between artificial intelligence and the robustness of humanitarian supply chains. A descriptive investigation and cross-sectional survey involving 88 humanitarian organizations in Uganda, with staff expressly selected for relief operations. Data was examined by partial least squares structural equation modeling to evaluate theories and ascertain the mediating effect. The research revealed that artificial intelligence directly affected regional logistical capabilities and significantly influenced the robustness of humanitarian supply chains indirectly. The results indicated that localized logistical capability completely mediates the connection between artificial intelligence and the robustness of humanitarian supply chains. Given that logistics capacity acts as a conduit linking artificial intelligence and the robustness of humanitarian supply chains, the research provides enhanced insights into how humanitarian entities can develop adaptive capabilities to navigate the intricate landscape of humanitarian endeavours. To establish resilience in humanitarian supply chains, managers must to adopt artificial intelligence and foster strong relationships with local logistical partners.

In their literature review study, Kochan et al, (2026) enumerated the difficulties faced by humanitarian supply chains, which include conflict assistance, disaster relief, and quick response.

The investigation formulated a systems dynamic paradigm to advance understanding of humanitarian supply chain resilience. Utilizing stakeholder interaction and trade-off theory, the study suggested pragmatic approaches to bolster resilience in humanitarian supply chains, particularly highlighting the significance of information technology capabilities through the Internet of Things, cloud computing, and blockchain to enhance coordination, transparency, and decision-making.

A systematic literature review regarding the application of artificial intelligence in humanitarian supply chains was conducted by Lythreatis et al, (2026). The research additionally examined the prospective applications of artificial intelligence outside humanitarian emergency scenarios. The results, derived from 60 meticulously selected cases, indicate that artificial intelligence applications during both pre- and post-crisis stages can be categorized into four specific groups, and that the role of artificial intelligence in broader humanitarian settings can similarly be divided into four focal domains. The pre-crisis phase encompasses site selection, enhancement of medical services, early warning systems, and information dissemination; the post-crisis phase includes distribution and delivery, damage evaluation, online and textual analysis, and routing optimization. The evaluation offers valuable insights for entities aiming to harness the transformative capabilities of artificial intelligence by emphasizing the technology's significant ability to enhance the effectiveness and efficiency of humanitarian efforts.

Focusing on disaster response and humanitarian logistics, Abdulrashid et al, (2026) conducted a comprehensive review examining the integration of artificial intelligence into decision support systems. The research discerned essential artificial intelligence methodologies, including machine learning, natural language processing, deep learning, reinforcement learning, and the integration of artificial intelligence with the Internet of Things, through an examination of peer-reviewed publications from 2008 to 2024. The research evaluated its application in essential humanitarian logistics functions such as final delivery, demand prediction, transportation routing, facility identification and prepositioning, as well as resource distribution amidst uncertainty. The findings of the study indicated that although recovery, mitigation, and enduring supply chain resilience remain inadequately explored, the focus of research is predominantly on natural catastrophes and first emergency response phases.

The research underscored numerous obstacles, including insufficient and disjointed datasets, limited interpretability of AI-driven models, isolated system architectures, and ethical concerns around equity and fairness in resource allocation. To enhance supply chain coordination, fairness in aid allocation, and decision-making quality across the humanitarian logistics continuum, it proposes a research agenda advocating for interpretable, interoperable, and context-aware artificial intelligence Disaster Support System frameworks.

The objective of Tetteh et al.'s (2025) research was to examine how organizational adaptability could enhance the effectiveness of big data analytics expertise, collaboration, and information synchronization on the robustness of humanitarian supply chains. A model consisting of six

hypotheses was developed based on the Organizational Information Processing Theory (OIPT). The hypotheses were evaluated utilizing data from 127 supply chain managers employed by humanitarian organizations. The analysis employed both descriptive and inferential statistics with SPSS version 26 and Smart-PLS version 3. The research indicated that organizational flexibility did not influence the connection between big data analytics capabilities, cooperation, and information alignment with humanitarian supply chain resilience; instead, these elements independently impact supply chain resilience in humanitarian contexts. The research indicates that to create a robust humanitarian supply chain capable of mitigating disaster effects, stakeholders must emphasize factors that enhance supply chain resilience through the application of contemporary big data analytics, effective information dissemination, and collaborative approaches. The research contributed to the existing knowledge by providing insights that enhance theoretical discourse on the influence of big data analytics capability, collaboration, and information alignment on supply chain resilience in humanitarian contexts, considering varying levels of organizational flexibility. The research additionally offers valuable guidance for managers in humanitarian organizations seeking to utilize information alignment, cooperation, and big data analytics to establish robust supply chains.

The application of digital twin technology to enhance the robustness of humanitarian supply chain management was examined by Srivastava & Bag, (2025). The provision of essential assistance has increasingly challenged humanitarian logistics organizations due to recent natural disasters. To address these challenges, companies are employing digital technologies such as digital twin technology to transform their operational methods. The theoretical framework for the resilience of humanitarian supply chains was evaluated by partial least squares structural equation modeling. The research indicates that humanitarian supply chain logistics services enhanced by digital twin technology derive resilience from three intangible factors: a culture of innovation, collaborative networks, and crowdfunding initiatives. The research expands the utilization of resource-based theory in the context of humanitarian supply chain resilience by employing digital twin technology. The proposed structural framework enhances the application of digital twins for the advancement of resilience.

Maghsoudi et al, (2025) investigated the supply chain interruptions and strategies for mitigation, using Syria as the focal point. Data acquisition was conducted through interviews and secondary sources. The research utilized causal loop diagrams to illustrate the relationships between essential supply chain factors. The research is fundamentally grounded in the Triple-A framework, which encompasses alignment, agility, and adaptability. The findings of the study underscore the importance of aligning humanitarian efforts with governmental objectives and facilitating a seamless transition between development initiatives and humanitarian assistance. To maintain continuity and significance in war-affected situations, the research emphasized the importance of adaptability in switching between modalities such as cash and voucher assistance, market-driven initiatives, and in-kind support.

To ascertain and prioritize the essential success factors in the humanitarian supply chain, Khoidir et al, (2025) developed a hybrid decision-making model that integrates the Intuitionistic Fuzzy TOPSIS (IF-TOPSIS) with the Intuitionistic Fuzzy Analytic Hierarchy Process (IF-AHP). The framework offers a structured and adaptable method for intricate decision-making by incorporating indecision and ambiguity in expert assessments. A dozen experts from Indonesian disaster response agencies engaged in the evaluation. A total of thirty-three sub-criteria and eight principal criteria were evaluated. The foremost critical success aspects include procurement and donation management, social media and communication platforms, and the empowering of emergency teams. Findings indicate the significance of agility, decentralized decision-making, and instantaneous communication for operational effectiveness. The research aids humanitarian supply chains by offering a replicable method for ranking critical success factors in unpredictable situations. The research proposed a framework that might enhance decision-making in humanitarian efforts and provides valuable recommendations for optimizing supply chain efficiency in disaster relief.

In order to mitigate environmental effects and enhance worldwide decarbonization initiatives, the study conducted by Ramirez-Villamil & Jaegler (2025) investigates the incorporation of sustainable methods within humanitarian supply chains. The research predominantly focused on a thematic synthesis of scholarly articles that investigated the environmental aspect of humanitarian logistics, published from 2011 to 2024. The results demonstrated that sustainable methods like waste minimization, resource-efficient transportation, and emissions monitoring were progressively more popular. The lack of established environmental rules, insufficient digital infrastructure, and operational complexities presented considerable obstacles. The study indicated that integrated environmental performance indicators, technological innovations, and cooperative initiatives among entities were promising avenues for improvement. Notable shortcomings remain in the assessment and standardization of environmental performance in humanitarian supply chains, despite increased awareness. The study suggested that further exploration and cooperative efforts be pursued to create consistent and scalable eco-friendly practices in humanitarian settings.

The research conducted by Yilmaz et al, (2025) evaluated the stress levels within the humanitarian supply chain in response to unpredictable demand surges following an earthquake, employing a thorough, lean-oriented approach that incorporates a philosophy of ongoing enhancement. The approach integrated a two-phase stochastic programming framework with the F-tag instrument and the value stream mapping (VSM) method. The catastrophic earthquake in Kahramanmaraş, Turkey in 2023 provides a foundation for a case study analyzing the repercussions of an earthquake in Istanbul, Turkey. Value stream mapping was employed in this scenario to illustrate Istanbul's immediate post-earthquake condition, depicting both the current and prospective states. The optimization model is employed to evaluate centralized versus decentralized distribution alternatives to enhance network resilience and bolster the overall sustainability of the supply chain amid the repercussions of disruptions. Employing the Red Tag Ratio as the dependent variable, an experimental framework is established to investigate the manageable factors and their interrelations.

Stentoft & Mikkelsen, (2024) aimed to enhance understanding of how small and medium enterprises might bolster their resistance to supply chain interruptions by engaging and coordinating cross-functional personnel in the development of supply chain robustness. Employing process theory, the research adopted a multiple case-study methodology including eighteen Danish small and medium-sized manufacturing enterprises across two iterative stages: an exploratory phase with eight case firms and a refining phase with an additional ten case firms. The research introduced a four-phase methodology aimed at enhancing supply chain resilience through a mixed-method strategy that encompasses semi-structured interviews, card sorting exercises, observational research, and a survey questionnaire. This process entails: charting the supply chain; assessing the vulnerabilities and strengths of each function; establishing priorities and promoting inter-organizational coherence; and devising action strategies. For entities aiming to mitigate risks and enhance competencies within their supply chains, the enhanced methodology—endorsed by the ten Danish small and medium enterprises throughout the refinement stage—provides a valuable and relevant framework. This approach can act as a blueprint for other entities seeking to achieve supply chain robustness by bolstering the resilience of small and medium enterprises against supply chain disruptions.

Wang et al, (2025) examined the combined impacts of carbon pricing policies and sustainable supply networks on the robustness of supply chains in Chinese A-share listed firms. The writers assert that escalating environmental degradation and severe weather conditions have heightened the occurrence of supply chain interruptions, posing challenges to sustainable development. The research confirms the beneficial synergistic impact of the dual policies on supply chain resilience through a multi-period difference-in-differences examination of firm-level data spanning from 2009 to 2023. The most significant enhancement in resilience was observed in firms who adopted the carbon price strategy before the sustainable supply chain initiative. The processes of supply chain effectiveness and sustainable innovation were found to facilitate these effects. In terms of heterogeneity, manufacturing firms, established enterprises, and privately owned corporations are more inclined to benefit from the synergistic effects of the dual policies on supply chain robustness. These findings offer crucial insights to assist policymakers in enhancing the robustness of supply chains.

Fan et al, (2025) examined the influence of digital technology-enhanced supply chain visibility on emergency management competencies. The research formulated a theoretical framework grounded in the resource-based perspective and slack theory, utilizing panel data from Chinese publicly traded firms spanning 2010 to 2020. The empirical framework uncovered an inverted U-shaped relationship between the dimensions, with supply chain integration serving as a mediating variable and corporate social responsibility acting as a moderating variable. The primary findings indicate that supply chain visibility presents an optimal operational range but does not enhance emergency management effectiveness in a linear fashion, while corporate social responsibility adversely influences the non-linear relationship. The research enhances theoretical frameworks and methodologies in sustainable supply chain advancement by incorporating corporate social

responsibility as an innovative moderator, elucidating the mediating function of supply chain integration, and empirically substantiating the non-linear association between supply chain visibility and emergency management.

The purpose of Zimmermann et al, (2025) paper was to expand knowledge of how supply chain visibility might improve the social sustainability of textile supply chains. Prior to and during the building of a technology-based solution, the researchers analyzed supply chain visibility in the context of two Portuguese textile supply chains using a longitudinal viewpoint and a combination of methodologies incorporated inside a design science methodology. The research is based on the premise that socio-environmental issues should be collectively addressed by all links in the supply chain. The study concluded that the difficulty of collecting partners' information, particularly after the first tier, is one of the key hurdles to insuring the sustainability of a supply chain. The textile sector is considered as a priority when it comes to social sustainability concerns because of its large geographic dispersion, high number of small firms, and, most crucially, the expansion of the fast fashion industry. Furthermore, clients are seeking additional information concerning the societal implications of products.

AlMahri et al, (2026) conducted a study to develop a novel framework that enhances supply chain visibility without relying on the sharing of information among stakeholders, employing Knowledge Graphs and Large Language Models. The writers assert that the lack of information sharing among supply chain partners' renders achieving visibility exceedingly challenging. The research not only develops organized knowledge graphs that encapsulate complex, multi-level relationships among supply chain entities, geographical areas, ownership frameworks, and product movements, but also employs a zero-shot, Large Language Model-based system to autonomously derive diverse, domain-specific supply chain data from publicly available resources. The approach was validated by both quantitative evaluations and a case study focused on the supply chains of electric vehicles, specifically highlighting the oversight of essential minerals for battery manufacturing. The results demonstrated the effectiveness of the system in mapping the supply chain, enhancing visibility to tier-2 suppliers. The methodology also recognizes alternative supply options and critical dependencies, enhancing risk management and strategic planning during disruptions. The research tackles persistent visibility challenges and paves the way for enhancements in digital supply chain monitoring by offering an innovative framework for developing domain-specific supply chain knowledge graphs.

In a related study, Zheng & Brintrup (2025) revealed that one hurdle to an organization's ability to successfully manage supply chain risk is a lack of understanding of interdependent supply chain network relationships. The study made the point that while current systems have demonstrated useful in forecasting relationships, they have problems detecting the environment in which these interactions are rooted, such as the objects or locations from which they are delivered. Accurate risk assessments are limited by organizations' inability to discern between transactional and established supply chain connections due to a lack of context. To predict supply chain connections inside knowledge graphs, this investigative initiative developed a machine learning framework

augmented by Generative Artificial Intelligence, utilizing pre-trained language models as embedding models alongside machine learning algorithms. The study enhances supply chain transparency and facilitates more precise risk management by using Generative AI methodologies to identify intricate semantic relationships among entities. The study illustrated the examination and effective use of generative artificial intelligence models in supply chain risk management, utilizing data from a real case study to demonstrate that generative artificial intelligence's enhanced link prediction surpasses all standards.

Mirzaei et al, (2025) investigated the potential of emerging technologies to enhance supply chain transparency within New Zealand's fishing industry. The research employs the technological affordance theory to examine the influence of technologies such as GPS trackers, RFID tags, and Internet of Things devices on operational efficiency and decision-making through the provision of valuable data insights. Real-time tracking, proactive management, and data-driven decision making are three essential technological affordances that were identified through a qualitative case study that includes interviews and workshops with industry professionals. The theory of technology affordances highlights the opportunities and difficulties faced by industry managers by offering insights into the linkages between technology and the socio-technical environment. Despite the substantial improvements in monitoring and sustainability afforded by these technologies, the research analysis indicates that their effectiveness is constrained by organizational collaboration, contextual elements, and user comprehension. The paper also underlines the deep linkages that exist between technology, user expectations, and supply chain performance, underlining the requirement of user-centric, integrated platforms to optimize the benefits of supply chain visibility. This study provides an in-depth comprehension of the components that link supply chain visibility technologies, attributes, and choices through their adoption and impact.

Sarioguz (2025) studied how intelligent control tower systems and generative artificial intelligence could help remove the growing need for real-time transparency in supply chains on an increasingly complicated and global logistics system. Intelligent control towers and generative AI combine to give a framework that enables the generation of dynamic data, the identification and forecasting of risks, and the autonomous planning of scenarios. The case-based research sheds light on the benefits of these technologies in terms of boosting prediction, expediting decision-making, and facilitating cross-functional synchronization in the supply chain. According to the findings, latency reduction, demand sensing, and disruption management are all improved when AI-enabled control towers are employed in organizations. The research additionally demonstrates that generative AI could facilitate adaptive learning due to its ability to produce valuable insights from unstructured data sources, including market signals and supplier interactions. These findings position intelligent control towers as essential mechanisms for enhancing resilience, agility, and creativity within a digital supply ecosystem, rather than just monitoring devices.

In their research regarding the comprehension of visibility impediments inside supply chains, Delgado et al, (2025) identified that the primary challenges included insufficient universal

legislation, distrust, infrastructure expenses, and inadequate data standards. The report also suggested potential avenues for future investigation. The research analyzed 20 articles employing the PRISMA methodology, identifying 12 notable barriers to visibility. A keyword co-occurrence study demonstrated robust connections across visibility, supply chain management, sustainability, and artificial intelligence, facilitated by Industry 4.0 technologies such as machine learning, predictive analytics, and digital twins. Future research ought to empirically investigate visibility challenges and analyze the correlation between AI-TI4.0, visibility, and sustainable performance using case studies and quantitative approaches.

To enhance supply chain transparency, offer insights into market dynamics, minimize inventory levels, and refine decision-making processes, Kanaan, (2025) examined artificial intelligence comprehensively and its relevance to supply chain management. Furthermore, it presents the concept of artificial intelligence as a significant driver of change in the modern supply chain environment. The research is based on quantitative data obtained from surveys and industry publications, alongside insights derived from conversations with industry experts and analyzes of firm cases. The paper indicates that supply chain visibility systems employing artificial intelligence might lead to a 20–30% decrease in inventory costs, a 30–50% reduction in stockouts, and projections that are up to 65% more precise. Furthermore, the paper emphasizes the risks and concerns linked to the implementation of AI in supply chain management, such as data privacy challenges and employment displacement.

The research conducted by Daios et al, (2025) provides a thorough evaluation of artificial intelligence implementations in essential supply chain management processes, including demand forecasting, procurement, transportation systems, inventory oversight, customer relationship management, and risk assessment. Machine learning, natural language processing, and generative artificial intelligence exemplify AI technologies that offer transformative methods to enhance demand forecasting, mitigate operational risk, and accelerate logistics. The research not only emphasizes the vital function of artificial intelligence in enhancing supply chain transparency and robustness amid global emergencies but also recognizes challenges to its adoption, such as implementation hurdles, organizational readiness, and ethical concerns. Future advancements will concentrate on addressing ethical and security concerns, enhancing digital sophistication, and creating human-centered artificial intelligence. The paper not only provides a framework for advanced research and application in supply chain management but also emphasizes the vital contribution of artificial intelligence in developing resilient, adaptable, and sustainable supply chains.

In their empirical research, Al-Zoubi and Ramayah, (2025) examined the influence of intellectual capital on the adoption of AI-driven supply chain analytics by manufacturing firms and the subsequent impact of these analytics on supply chain innovation and agility. A total of 252 participants overseeing supply chains for manufacturing firms in Jordan contributed the information. The hypotheses were evaluated utilizing AMOS software, which employs the Structural Equation Modeling approach. The research revealed that the three components of

intellectual capital—human, structural, and social capital—exerted beneficial impacts on AI-driven supply chain analytics. It further validated that AI-driven supply chain analytics positively influenced supply chain innovation and agility. Ultimately, the empirical results corroborated the notion that supply chain agility positively influenced supply chain innovation. This research enriches the understanding of supply chain analytics and its role in improving the adaptive capabilities of manufacturing companies, including supply chain innovation and agility, while also providing valuable practical insights.

Maagi's (2025) study attempted to use the queuing model technique to explore how supply chain agility influences service delivery in humanitarian-based transport operations. The Tanzania Port Authority was the site of the study. The study included secondary data sourced from the World Bank, the National Bureau of Statistics, and the official database of the port authority. The research employed simulation-derived data within the M/M/1 queuing framework to determine the customer arrival rate via the Poisson distribution and the service waiting duration through the exponential distribution. Data analysis and results were conducted using the RStudio programming tool. The findings suggest that the average length of time spent in line is 0.75, the mean arrival rate is 0.75, the traffic intensity is 0.75, and the possibility of customers being in the queuing system is 0.25. The Interval Exponential Distribution indicated that the likelihood diminished as inter-arrival time increased, whereas the Poisson distribution revealed that the probability of service provision reached its zenith at three clients per minute. The study came to the conclusion that in humanitarian operations, supply chain agility increases service delivery. By linking these concepts from a supply chain viewpoint in Tanzania, the study has presented a novel and innovative technique. The research indicates that supply chain agility enhances responsiveness in delivering services for commodities with humanitarian purposes.

The research conducted by Rasool et al, (2025) investigated the influence of risk management as a moderating factor while assessing the mediating function of supply chain agility on IT competency and supply chain performance within the hotel industry. The authors employed a questionnaire to collect data from 302 full-time managers in the hotel and restaurant sector in Pakistan. The research results indicate a favorable correlation between supply chain performance and IT proficiency, with supply chain agility serving as a mediating factor in this connection. Moreover, it has been determined that risk management serves as a vital boundary condition that alters both the direct and indirect relationships between supply chain performance and IT proficiency.

Singh & Kumar, (2025) studied how industry factors affected the links between supply chain resilience and agility as well as supply chain flexibility and resilience. Furthermore, the research examined the influence of engagement capabilities, supply chain integration, and data analytics capabilities on supply chain resilience. A self-directed instrument was created, and data was collected from experts in the supply chains of India's heavy machinery, steel, electronics, energy, and textile sectors. The hypothesis was validated using structural equation modeling, which analyzed 681 responses received. The findings highlight the essential function of engagement

abilities in advancing data analytics and supply chain integration, therefore enhancing supply chain adaptability. The results also suggest that supply chain flexibility promotes supply chain resilience and agility, stressing the requirement of adaptability. Notably, the relationships among supply chain flexibility, agility, and resilience are partially influenced by the volatility of the industry. By analyzing how industry dynamism effects the linkages between supply chain flexibility, agility, and resilience, the study brings a unique perspective and expands on existent supply chain management theoretical frameworks.

Elshaer et al, (2026) maintain that the hotel business has encountered exceptional interruptions, such as international health emergencies, political instability, and climate change, stressing the importance of developing supply chain systems that are increasingly robust and flexible. The investigation analyzed the role of artificial intelligence abilities in generating competitive advantage, with supply chain resilience and agility functioning as mediators and competitive pressure as a moderating variable. The analysis put forth and experimentally assessed the model founded on the resource-based view theory. The investigation utilized Partial Least Squares Structural Equation Modeling to assess data from 432 hotel managers in Egypt. The evidence reveals that supply chains utilizing artificial intelligence can substantially bolster their durability and responsiveness. In addition, supply chain resilience and agility may serve as effective conduits, with competitive pressure potentially elevating the tested associations to a moderate degree. By merging artificial intelligence capabilities with supply chain agility and resilience frameworks in the context of hotels and tourism, the study offered numerous theoretical and practical contributions, providing essential evidence for professionals intending to leverage AI-driven supply chain tools to navigate uncertainty and cultivate a sustainable competitive advantage.

The aim of Sa'ada (2026) was to assess the significance of humanitarian supply chain management in light of diverse conditions. It mainly focuses on the quality of information exchange, encompassing timeliness, accuracy, comprehensiveness, reliability, and sufficiency. A review process is applied. The reviewed articles ranged from 2000 to 2019. The research uncovered several challenges, such as inadequate communication and comprehension, humanitarian skills, external factors, and understanding. Furthermore, it provided a structure for mitigating the difficulties linked to disaster relief initiatives. Another unique strategy in humanitarian supply chain management is the introduction of many information quality criteria and their direct relation to evaluating supply chain sustainability and agility. It highlights how crucial technical expertise, teamwork, information, and communication are to ensure supply chain sustainability and agility.

Mubarik et al, (2025) examined how supply chain collaboration mediates the relationship between practices of supply chain innovation and the decarbonization of supply chains. The Malaysian electrical and electronics industry provided the framework for the investigation. A closed-ended questionnaire was utilized to obtain data from 156 companies. To analyze these associations, the study utilized partial least squares structural equation modeling. The study's outcomes emphasize the essential role of innovation in sustainability projects by validating a significant direct effect of supply chain innovation approaches on the decarbonization of supply chains. Opposing

widespread notions, supply chain collaboration does not markedly moderate this connection, implying that mere cooperation is insufficient to directly advance decarbonization results. In contrast, supply chain mapping functions as a crucial facilitator, underscoring its role in translating supply chain innovation efforts into successful carbon mitigation measures. By separating mapping from collaboration as facilitators of decarbonization, our findings conceptually enhance the discourse on supply chain sustainability. The analysis highlights the imperative for enterprises to allocate funds toward digital supply chain mapping technology to bolster visibility and facilitate decision-making about decarbonization strategies.

To categorize the various impacts of artificial intelligence applications on supply chain partnerships, Weisz et al, (2025) concentrated on the essential elements of trust and information exchange. The research utilized literature on artificial intelligence technology and collaboration, alongside the effects of trust and information exchange, to present two frameworks that clarify the relationships between artificial intelligence competencies, trust, and information sharing. The authors categorized artificial intelligence collaboration into five phases after recognizing varying degrees of interdependence between trust and AI capabilities. These phases encompass augmentative artificial intelligence applications, collaborative artificial intelligence applications, autonomous artificial intelligence applications, complementary artificial intelligence applications, and artificial intelligence applications that supplant existing systems. To assist managers in classifying the supply chain collaboration phase of an organization's artificial intelligence progression, a five-tiered framework for supply chain AI cooperation is introduced. The study's classification offers insights into collaborative practices and serves as a valuable management tool for comprehending the application of artificial intelligence capabilities within a supply chain context.

The research conducted by Yu et al, (2025) assessed how digital transformation influences collaborative innovation in supply chains and its subsequent impact on market performance. Analyzing a sample of 210 Chinese enterprises, the study applied partial least squares-structural equation modeling (PLS-SEM) to evaluate the effects of digital transformation on supply chain collaborative innovation and market performance. The outcomes illustrate that digital strategy and capability significantly affect both supply chain collaboration and product innovation, enhancing market performance, while collaborative innovation mediates the connection between market performance and digital transformation.

Silva et al, (2025) aimed to identify the three facets—technology, transactions, and collaboration—that propel the integration of blockchain technology inside a supply chain context. A thorough and methodical examination of previous studies was conducted. The scholars categorized elements influencing blockchain technology in supply chains from the current literature into three primary dimensions: technology, transactions, and supply chain collaboration. These three facets are underpinned by the integrated theory of technology acceptance and use, transaction cost economics, and principles of supply chain cooperation. They subsequently suggested a conceptual framework that includes these three aspects. The research indicates that the primary impetus for

blockchain adoption inside the supply chain framework is information sharing linked to the collaboration aspect. Performance expectancy ranks second, while behavioural uncertainty occupies the third position.

A systematic study of the literature on sustainable humanitarian supply chains in disaster relief and development aid logistics was carried out by Anjomshoae et al, (2025). Based on a categorical analysis of research publications, the systematic review detected and categorized themes linked to sustainable humanitarian supply chain management, with a focus on theoretical development. The thematic analysis indicates that sustainability in humanitarian supply chains encompasses a wide array of components, such as performance assessment, supply network configuration, coordination, and collaboration. However, not all aspects of sustainability are frequently covered in theoretical study. The authors contend that the results of this systematic study may inform policy-oriented research directions and enhance our comprehension of the sustainability of humanitarian supply chains. The governance of the humanitarian supply chain can achieve greater sustainability through the implementation of these regulations.

The study by De Wet et al, (2025) analyzed the effect of information quality and inter-organizational exchange among humanitarian entities in Southern Africa during disaster response. Findings from the study suggest that the prompt circulation of quality information is crucial for the success of humanitarian supply chains. Semi-structured interviews were conducted with ten individuals affiliated with humanitarian aid groups in Southern Africa to gather information. The research was conducted utilizing a thematic analysis framework. The findings suggest that successful information sharing in disaster response is crucial for achieving coordination, transparency, and operational effectiveness. This can be attained through practices that involve assemblies, humanitarian relationship coordination, and cluster-focused initiatives. Quality information is defined by its accuracy, clarity, and reliability, which are maintained by expert quality assurance teams, manual reviews, and data cross-verification. The challenges of data duplication, limited interaction among stakeholders, and ethical issues are merely a few of the prominent hurdles that remain, stressing the imperative for superior tools and strategies to resolve them.

Mazar et al's (2024) qualitative multiple case research aimed to explore the methods utilized by United Nations supply chain managers to leverage operational efficiency in humanitarian projects. The investigation incorporated direct observations, document scrutiny, artifacts, and semi-structured interviews with nine supply chain managers from the United Nations to apply the qualitative multiple case study methodology. The cornerstone of the investigation is based on dynamic capability theory. The study uncovered three themes that delineated several tactics utilized by United Nations supply chain managers to secure operational efficacy: effective leadership methodologies for supply chain management; strategies for the management of knowledge, innovation, and analysis; and strategies for risk management. The authors maintained that earlier research revealed an absence of strategic frameworks tailored to the United Nations,

which could facilitate enhanced decision-making, encourage cooperation among supply chain entities, and diminish operational costs in the United Nations supply chain system.

Wang et al, (2024) investigated the impact of digital transformation on the efficiency of supply chains, utilizing 392 answers from a port-hinterland supply chain in western China. Structural equation modeling revealed that supply chain transparency and agility collectively established a positive full mediating pathway from digital transformation to efficiency; after incorporating these mechanisms, the direct benefit of digital transformation was no longer statistically significant. Wang & Prajogo (2024) analysed 271 firms in the United Arab Emirates to determine whether supply chain digitalisation improves firm performance through supply chain agility and innovation capability. Their structural equation model showed that the digitalisation–performance relationship was fully mediated by agility and innovation, while the interaction between the two capabilities could, under some conditions, generate unfavourable performance outcomes. The evidence therefore supports the strategic importance of agility while demonstrating that digital transformation is not automatically beneficial in every configuration.

The empirical analysis uncovers distinct contextual, specification, and geographical gaps. Primary evidence from Nigeria is exceedingly few, and there is less research addressing automated logistics coordination while analysing Collaboration, Visibility and Agility as separate dimensions of resilience.

Initially, the geographical distribution of available evidence is inconsistent. A significant portion of the empirical research originates from commercial supply chains, humanitarian entities beyond Nigeria, or relatively more digitized contexts in Asia, Europe, the Middle East, and Southern Africa. Data regarding AI-facilitated humanitarian logistics in Nigeria is scarce, despite the humanitarian sector functioning amidst ongoing challenges related to infrastructure, security, funding, and intergovernmental collaboration that can significantly impact the benefits derived from digital technologies.

Secondly, the theory of socio-technical systems remains insufficiently examined. The preponderance of research favours the dynamic capability or optimization hypothesis. This research will enhance the understanding of socio-technical systems theory. The investigation will evaluate the subsequent hypothesis based on these gaps.

H01: Automated Logistics Coordination does not significantly influence the Humanitarian Supply Chain Visibility;
H02: There is no significant effect of Automated Logistics Coordination on Collaboration in Humanitarian Supply Chain;
H03: There is no significant effect of Automated Logistics Coordination on the Agility of Humanitarian Supply Chain.

METHODOLOGY

The research utilizes a realism ontological assumption alongside a primarily positivist epistemological stance. This study, consistent with a largely positivist stance, utilizes a deductive strategy to test hypotheses generated from the theoretical and conceptual framework via quantitative questionnaire data. The design is explanatory, utilizing a cross-sectional survey design to evaluate the direction, strength, and statistical relevance of the associations between Automated Logistics Coordination and the three facets of Humanitarian Supply Chain Resilience: Visibility, Collaboration, and Agility.

The target group of this study was workers in the Nigerian Humanitarian Sector using a stratified random sampling to ensure representation throughout the six geopolitical zones. Cochran's formula was employed to estimate the sample size using the generally accepted confidence level of 95%, a 5% margin of error and a 0.5%, a sample size of 384 was determined. The survey was first distributed digitally to employees in the humanitarian field. Based on delayed response rate attained via electronic administration, physical surveys were next administered at the offices that were accessible. Data collection was discontinued after six months with 258 questionnaire records available for analysis, representing 67.2% attainment of the planned sample. The obtained sample was thus examined transparently, using supplementary sensitivity analyses to determine if absent data, atypical response trends, and uneven regional distribution significantly altered the primary conclusions.

The investigator meticulously crafted closed questions that directed opinions toward the topic under examination. Surveys are advised for quantitative research. They are utilitarian and amenable to standardization. The investigator recognized the limitations of surveys and made certain that the inquiries were sufficiently rigorous to obtain the necessary data (Cresswell & Cresswell, 2023). This research utilized questionnaires derived from Singh's investigation into collaboration, agility, and sustainable outcomes in supply chains (2025), Pettit et al's work on supply chain resilience evaluation (2013), Pereira & Shafique's examination of artificial intelligence's impact on supply chain agility from a humanitarian perspective (2024), Kaviani et al.'s analysis of vulnerability and capability in the automotive sector (2020), Pantiris et al.'s exploration of AI's role in improving coordination and decision-making in humanitarian logistics (2025), Al-Humdan et al.'s empirical research on agile supply chains in Australia (2024) and Al-Zoubi & Ramayah's study on the facilitation of supply chain agility and innovation through AI-based analytics (2025).

The principal inferential technique employed was multiple linear regression. Prior to hypothesis testing, the data underwent scrutiny for coding inaccuracies, absent values, repetitive response patterns, linear responding, and significant findings. Frequencies, percentages, averages, standard deviations, skewness, and confidence intervals were employed to characterize respondents, items, and composite constructs. The quality of measurement was evaluated by Cronbach's alpha and

McDonald's omega. The Pearson correlations were analyzed before to estimating the regression models.

Automated Logistics Coordination serves as the independent variable in this research. The dependent variable is Humanitarian Supply Chain Resilience, which is represented by Humanitarian Supply Chain Visibility, Humanitarian Supply Chain Collaboration, and Humanitarian Supply Chain Agility. The model specification is derived from the works of Wang et al. (2025) and Li et al. (2025) as outlined below:

Humanitarian Supply Chain Resilience (HSCR) = f (Automated Logistics Coordination (ALC)

$HSCA = \beta 0 + \beta 1 ALC_i + \varepsilon_i$ (3.1)

$HSCV = \beta 0 + \beta 1 ALC_i + \varepsilon_i$ (3.2)

$HSCC = \beta 0 + \beta 1 ALC_i + \varepsilon_i$ (3.3)

Where:

HSCA =Humanitarian Supply Chain Agility;

HSCV = Humanitarian Supply Chain Visibility;

HSCC = Humanitarian Supply Chain Collaboration;

ALC = Automated Logistics Coordination;

ε = Error Term

$\beta 0$ represents the intercept, $\beta 1$ and $\beta 2$ are the partial regression coefficients for Automated Logistics Coordination respectively, and ε_i represents the stochastic error term for respondent i.

RESULTS/FINDINGS

The supplied questionnaire workbook contained 258 respondent records out of a planned sample of 384. The available records therefore represent 67.2% of the planned sample.

Table 4.1: Data Integrity and Sample Realisation

Indicator	**Result**	**Analytical treatment**
Planned sample	384	Cochran population target
Available questionnaire records	258	Observed cases
Sample attainment	67.2%	Available cases / planned sample

Data Analysis

Demographic Characteristics of Respondents

Characteristic	Category	n	%
Gender	Male	164	63.5%
	Female	94	36.5%
Age Group	41-50	94	36.5%
	31-40	62	23.9%
	21-30	55	21.4%
	51-60	41	15.7%
	41-60 (as entered)	5	1.9%
	Missing	2	0.6%
NEMA location	Headquarters	125	48.4%
	North-Central	60	23.3%
	South-South	57	22.0%
	South-East	8	3.1%
	North-West	5	1.9%
	South-West	3	1.3%
Educational qualification	Bachelor's degree/HND	151	58.5%
	Master's degree	71	27.7%
	Diploma/OND/NCE	18	6.9%
	Doctorate (PhD)	16	6.3%
	Missing	2	0.6%
Job rank / cadre	Senior Staff	130	50.3%
	Management Staff	67	25.8%
	Junior Staff	39	15.1%
	Executive Management	16	6.3%
	Missing	6	2.5%
Years of NEMA experience	16-20 years	71	27.7%
	0-5 years	70	27.0%
	11-15 years	57	22.0%

Characteristic	Category	n	%
	6-10 years	29	11.3%
	Over 20 years	28	10.7%
	Missing	3	1.3%
Department	Human Resources	70	27.0%
	General Services	44	17.0%
	Planning	41	15.7%
	Accounts	36	13.8%
	Special Duties	23	8.8%
	Information Technology	16	6.3%
	Operations	15	5.7%
	Procurement	11	4.4%
	Missing	3	1.3%

Table 4.2 presents a summary of the responder characteristics and reveals significant organizational experience in the evaluation of NEMA's supply chain operations. The sample consisted of 63.5% men and 36.5% women. The most significant age demographic was 41–50 years, where 58.5% of individuals had a Bachelor's degree or Higher National Diploma, and 27.7% possessed a Master's degree. More than three-quarters of the responders were comprised of senior and management staff. The distribution of experience was extensive, featuring individuals with 0–5 years and considerable segments with 11–20 years. These features imply that the dataset reflects both practical and experiential organizational insights, however the earlier noted regional imbalance continues to be a crucial consideration.

Measurement Quality Assessment

Table 4.3: Reliability, Factorability and Convergent-Variance Diagnostics

Construct	n	α	KMO	Bartlett χ^2	df	p	AVE
ALC	256	0.847	0.831	319.14	10	< .001	0.532
HSCV	253	0.723	0.769	161.57	15	< .001	0.321
HSCC	256	0.682	0.655	182.89	21	< .001	0.250
HSCA	255	0.685	0.623	182.24	15	< .001	0.278

α = Cronbach's alpha; AVE = average variance extracted. Bartlett's tests were significant at $p < .001$ for every construct.

As indicated in Table 4.3, Automated Logistics Coordination demonstrated good internal consistency (α = 0.847), while Visibility likewise exceeded 0.70 (α = 0.723). Collaboration and

Agility exhibited α values of 0.682 and 0.685, respectively, both falling just below 0.70. These scale is consequently viewed as moderately dependable. The KMO values ranged from 0.623 to 0.831 and all Bartlett tests were highly significant, indicating that the inter-item correlation matrices contained adequate shared variance for factor analysis.

Descriptive Analysis of the Study Constructs

Automated Logistics Coordination

Table 4.4: Respondents' Assessment of Automated Logistics Coordination in NEMA

Rank	Item	N	Mean	SD
4	Artificial Intelligence software automatically routes relief vehicles	258	2.85	1.03
5	Artificial Intelligence coordinates warehouse-to-distribution movement	258	2.77	0.99
1	Automated platforms synchronise volunteers/NGOs	256	3.21	1.08
3	Artificial Intelligence supports logistics decision-making/coordination	257	2.91	1.00
2	Artificial Intelligence coordinates logistics across multiple stakeholders	257	2.95	1.10

Table 4.4 indicates that ALC exhibited the minimal construct mean in the research, M = 2.936 (SD = 0.820; 95% CI [2.807, 3.065]). All five item averages resided under the 'unsure' category. The automated synchronization of volunteers and NGOs received the greatest rating (M = 3.21), whilst the coordination of Artificial Intelligence from regional warehouses to distribution sites received the lowest rating (M = 2.77). The automated dispatch of relief vehicles continued to be minimal (M = 2.85).

Humanitarian Supply Chain Visibility

Table 4.5: Respondents' Assessment of Humanitarian Supply Chain Visibility

Rank	Item	N	Mean	SD
1	Information systems accurately track operations	254	3.86	0.84
4	Real-time data on supplies/equipment/employees	255	3.68	0.96
3	Regular information interchange with partners/security agencies	254	3.84	0.86
5	Technology ensures real-time visibility/transparency	255	3.46	0.95
2	Data analysts make records visible/consistent/accessible	256	3.84	0.88
6	Electronic information systems track all operations	256	3.40	1.10

According to Table 4.5, Visibility received an overall postive rating, M = 3.676 (SD = 0.604; 95% CI [3.580, 3.773]). Participants assigned the highest rating to precise operational tracking (M = 3.86), with analyst-assisted record visibility and accessibility (M = 3.84) and consistent information sharing with partners and security authorities (M = 3.84) closely trailing. The least prioritized elements pertained to global electronic monitoring of all activities (M = 3.40) and technology-facilitated instantaneous visibility throughout the complete procedure (M = 3.46). The pattern indicates significant visibility potential, although lacks comprehensive end-to-end digital transparency.

Humanitarian Supply Chain Collaboration

Table 4.6: Respondents' Assessment of Humanitarian Supply Chain Collaboration

Rank	Item	N	Mean	SD
3	Collaborative demand forecasting uses shared data	258	3.80	0.87
5	Open data ecosystem across responding partners	256	3.69	0.85
7	ERP is effectively utilised in supply chain	256	3.46	1.02
6	Collaboration technologies foster trust/collaboration	256	3.58	0.88
4	Data sharing synchronises demand projections	256	3.72	0.92
2	Strategic alignment with partners on response plans	256	3.95	0.96
1	Tight cooperation with partners on response strategies	256	3.97	0.93

Table 4.6 indicates that Collaboration exhibited a notably elevated mean of 3.740 (SD = 0.540; 95% CI [3.655, 3.825]). The most significant factors were close collaboration with partners about response methods (M = 3.97) and strategic concordance with partners on emergency plans (M = 3.95). The least favourable aspect was the efficient implementation of enterprise resource planning inside the supply chain (M = 3.46). The disparity indicates that cooperation is more effectively maintained via inter-organizational connections and strategic planning rather than through a completely unified digital corporate platform.

Humanitarian Supply Chain Agility

Table 4.7: Respondents' Assessment of Humanitarian Supply Chain Agility

Rank	Item	N	Mean	SD
1	Effective early-warning system identifies emerging needs	256	4.26	0.79
5	Real-time situational awareness identifies shifting needs/gaps	256	3.81	1.00
6	Real-time field oversight detects/resolves disruptions	255	3.61	1.00
3	Adaptive logistics enables rapid redeployment	255	3.92	0.79
4	Logistics enables rapid reallocation of relief assets	255	3.89	0.82
2	Supply chain can scale/redirection as conditions change	255	3.98	0.88

Table 4.7 reveals that Agility achieved the highest construct mean, M = 3.914 (SD = 0.551; 95% CI [3.827, 4.001]). The early-warning component was notably robust (M = 4.26), but the capacity to grow and reallocate life-saving resources also garnered a commendable rating (M = 3.98). Real-time field supervision for prompt disruption resolution was the least agile factor (M = 3.61), however it still fell within the agreement spectrum.

Construct-Level Correlations

Table 4.8: Pearson Correlations among the Study Constructs

Construct	ALC	HSCV	HSCC	HSCA
ALC	1.000			
HSCV	0.407***	1.000		
HSCC	0.362***	0.692***	1.000	
HSCA	0.178*	0.584***	0.701***	1.000

Note. * p < .05. ** p < .01. *** p < .001. Correlations are pairwise based on available composite scores.

Table 4.8 illustrates that all bivariate associations were positive. ALC shown a significant correlation with Visibility (r = 0.407) and Collaboration (r = 0.362), both p <0 .001, whereas its correlation with Agility was less pronounced (r = 0.178, p = 0.027). The aspects of resilience were significantly interconnected, especially Visibility with Collaboration (r = 0.692) and Collaboration with Agility (r = 0.701). The correlation pattern is consistent with the higher-order resilience data and also explains why simultaneous multivariate analysis is useful.

Test of Hypothesis

The main inferential model utilized is HC3 heteroscedasticity-resistant multiple regression. It evaluates the projected shift in the applicable resilience score correlated with a one-unit modification in an Automated Logistics Coordination component. The standardized coefficient β reveals comparative strength, the 95% confidence interval signifies precision, Cohen's f^2 illustrates the predictor's individual contribution, and the p-value is analysed at the .05 significant level.

Table 4.9: Regression Analysis

	β
Independent Variable: Automated Logistics Coordination (ALC)	

Hypothesis One: Automated Logistics Coordination and Humanitarian Supply Chain Visibility

H01 states that Automated Logistics Coordination does not significantly influence the Humanitarian Supply Chain Visibility. The HSCV coefficient is positive (B = .143, HC3 SE = .066, β = .190, t = 2.155), and the confidence interval closely omits zero. H01 is thus rejected. A single-unit rise in ALC correlates with an anticipated .143-unit rise in Visibility. The confidence interval is considerably broad in relation to the point estimate, spanning from .012 to .274. Cohen's f^2 = .038 is minimal, hence the outcome should not be characterized as a robust automation impact despite meeting the .05 significance criterion in the primary model.

Hypothesis Two: Automated Logistics Coordination and Humanitarian Supply Chain Collaboration

H02 states that Automated Logistics Coordination has no significant influence on Humanitarian Supply Chain Collaboration. HSCC has B = .066, HC3 SE = .059, β = .100, t = 1.129). Because p exceeds .05 and the confidence interval crosses zero, there is inadequate evidence to reject H02. The correct inference is therefore "fail to reject H02", rather than "accept H02". The quantitative implication is a one-unit increase in ALC is estimated to correspond to only a .066-unit increase in HSCC. Nonetheless, as the confidence interval spans from a slight negative value (-.050) to a positive value (.182), the data are consistent with the absence of an average change and with effects that could manifest in any way within that spectrum. The f^2 value of .010 falls short of the standard .02 threshold for modest effects. Thus, it would be statistically inappropriate to state that adding one unit of automation will improve collaboration by .066 points as a dependable operational outcome.

Hypothesis Six: Automated Logistics Coordination and Humanitarian Supply Chain Agility

H03 states that There is no significant effect of Automated Logistics Coordination on the Agility of Humanitarian Supply Chain. Table 4.9 presents an HSCC coefficient that is virtually null (B = -.004, HC3 SE = .066, β = -.006, t = -.063). H03 is hence not rejected. A one-unit rise in ALC correlates with an anticipated -.004-unit alteration in Agility. The confidence interval indicates that the population association could plausibly range from a .134-point decrease to a .126-point increase. Consequently, the research offers no justifiable foundation for asserting that merely enhancing automated logistics coordination will render the Humanitarian Supply Chain in Nigeria more adaptable given the current operational circumstances.

DISCUSSION OF FINDINGS

According to Table 4.9, the first hypothesis resulted in a positive but slight ALC–Visibility coefficient (B = .143, β = .190, p = .033), implying that an increase of one unit in ALC corresponds to just a .143-unit increase in Visibility. This is largely in agreement with Dede et al. (2024), who pinpointed transparency and last-mile visibility as resilience benefits of Artificial Intelligence in Nigeria, and with Pantiris et al. (2025), whose humanitarian research associated Artificial Intelligence with superior planning and coordination. The implementation of automated logging, confirmation of dispatch, and synchronization of workflows can likely produce digital markers that render the position and status of relief resources more apparent.

Nonetheless, the current impact lost its significance under other scoring and selected-control criteria, hence the outcome should not be regarded as consistently reliable. This warning is corroborated by Li et al. (2025), whose configurational examination indicated that superior performance depended on the interplay of visibility and transparency rather than on individual capabilities, and by Vann Yaroson et al. (2025), who discovered that direct relationships associated with Artificial Intelligence could vanish in the absence of responsible governance and socio-technical alignment. The STS Theory elucidates this vulnerability. An automated transaction can enhance visibility solely when the foundational data is current, devices and systems are compatible, employees adhere to the workflow consistently, and partner organizations can retrieve pertinent information. Quantile analysis in this research indicates that ALC is most effective with diminished levels of Visibility and provides minimal further distinction in the upper quartile. Implementation should consequently commence in operational sectors exhibiting the most evident traceability shortcomings, employing baseline and post-pilot visibility indicators, and maintaining human validation as data quality and interoperability develop.

The second hypothesis remains is not rejected due to the ALC–Collaboration coefficient being minimal and statistically insignificant (B = .066, β = .100, p = .261). Despite the positive point estimate, the confidence interval encompasses zero, rendering the one-unit effect an unreliable operational advantage. This contrasts with Singh (2025a), who noted substantial technology-driven advancements in humanitarian cooperation, and with Pantiris et al. (2025), whose specialists characterized Artificial Intelligence as an enabler of inter-organizational collaboration. Yildiz and Biyikli (2025) likewise stated that digital transformation might increase collaboration, trust and information flows in humanitarian logistics. The disparity suggests that the collaborative worth of digital technology relies on the nature of the digitized content, the level of implementation maturity, and the restructuring of organizational relationships in conjunction with technical processes.

Wang et al. (2024) additionally discovered that digital transformation did not have a substantial direct impact on efficiency after transparency and agility were integrated. These studies endorse a perspective that views technology as a facilitating factor rather than a replacement for relational governance.The null outcome aligns very well with the fundamental STS thesis. Collaboration is a social-organizational competency characterized by mutual objectives, trust, accountability,

decision-making authority, and reciprocal information sharing. Automating logistics operations can align transactions without establishing these relationship prerequisites. Humanitarian supply chains in Nigeria ought to adopt collaboration-focused automation solely after establishing inter-agency data standards, escalation protocols, responsibilities, service expectations, and exception procedures. Joint training and governance arrangements are likely to be as crucial as the software itself. The insignificant coefficient serves as a cautionary note against conflating process automation with collaborative abilities.

The ALC coefficient for Agility is virtually negligible (B = -.004, β = -.006, p = .950). An increment of one unit in ALC results in an estimated alteration of only -.004 units in Agility, a degree that is virtually indistinguishable from no typical variation. This stands in opposition to affirmative findings from Singh (2025a) and Al-Zoubi & Ramayah (2025), who associate digital or Artificial Intelligence-enhanced capabilities with supply-chain agility. Wang and Prajogo (2024) similarly mention agility as a key channel through which digitization might influence performance. The difference is substantively essential since such research evaluate larger digitalisation or analytics capabilities, whereas the present build isolates automated logistics coordination within the Nigerian humanitarian area.

Findings by Wang et al. (2024) illustrate the potential disappearance of a direct automation effect. Both investigations indicate that digital or Artificial Intelligence proficiency may necessitate intermediary organizational processes prior to yielding intended results. In Nigerian Humanitarian sector, automation may standardise normal movement, inventory or communication operations, but agility concerns rapid reconfiguration when routes fail, security conditions alter, infrastructure is damaged or demand moves unexpectedly. In such circumstances, unflexible processes, insufficient data, or ambiguous authority may constrain the beneficial impact of automation.

STS Theory predicts just this scenario. Agility arises from a collaboratively optimized framework where technical instruments, personnel, authority, infrastructure, and adaptable processes coexist together among upheaval. The implication of implementation is to conceive ALC as adaptive enhancement instead of unmonitored replacement. Systems must facilitate anomaly identification, manual intervention, offline or diminished functionality, alternate pathways, audit logs, and swift escalation. Agility should be evaluated with objective response-time, rerouting and service-recovery indicators before automation is spread across the Nigerian humanitarian sector.

Implication to Research and Practice, Conclusion, Further Research

Automated Logistics Coordination exhibited a frail and contingent trend. Participants indicated a relatively higher level of early-warning, visibility, collaboration, and agility compared to automated logistics coordination. The outcome of the Automated Logistics Coordination – Visibility was contingent upon model formulation and sample makeup.

This differentiation aligns with the empirical analysis. Pantiris et al. (2025) indicated that Artificial Intelligence has the potential to enhance planning, forecasting, and inter-organizational

coordination in humanitarian logistics, while also highlighting the importance of data dependability, field conditions, trust, training, and the equilibrium between algorithmic assistance and human expertise. Ahatsi & Olanrewaju (2025) likewise discovered that Artificial Intelligence and big-data analytics can enhance the robustness of humanitarian supply chains in Ghana and South Africa, while technical proficiency and infrastructure continue to pose significant obstacles to adoption. The humanitarian evidence from Nigeria reinforces these claims by demonstrating that sophisticated logistics automation has not yet been adequately integrated to produce consistent improvements in all resilience metrics.

The correlation between Automated Logistics Coordination and Visibility is modest yet sensitive to specifications, whereas its individual associations with Collaboration and Agility lack statistical significance. There is a lack of evidence indicating that automated execution is adequately incorporated to yield significant improvements in collaboration or agility. This differentiation is significant for strategy since an automation-centric initiative may deplete limited resources without addressing the socio-technical factors that influence the reliability of automated processes during humanitarian crises. The primary focus is to enhance data quality, provide common operational visibility, and refine inter-agency decision-making processes, subsequently broadening automation after these fundamentals are sufficiently developed.

Automated Logistics Coordination primarily engages in orchestration and implementation. In the Nigerian humanitarian sector, Automated Logistics Coordination is characterized by lower maturity and diminished statistical stability. The robust higher-order resilience framework provides an additional theoretical perspective. Visibility, Collaboration, and Agility are sufficiently separate to address the proposed hypotheses, yet they function as closely interrelated expressions of a shared resilience capability. This aligns with the Socio-Technical Systems perspective of an organization as an interactive entity. Visibility offers insights into operational conditions; Collaboration synchronizes participants with that knowledge; Agility transforms information and synchronization into prompt adjustments. A deficiency in one component can therefore restrict the worth of another.

The paradoxical observation of considerable resilience coupled with limited acceptance of Artificial Intelligence holds theoretical significance. It indicates that the Nigerian humanitarian industry has significant non-Artificial Intelligence resilience assets, such as skilled personnel, early-warning protocols, collaborative partnerships, and traditional information systems. Automated Logistics Coordination ought to be developed to enhance these resources instead of supplanting them. The empirical evidence endorses a human-centric digital transformation approach where technology enhances the scope and pace of existing competencies, while human discernment is accountable for extraordinary, ethical, and context-aware choices.

CONCLUSION

This research aimed to evaluate the connection between Automated Logistics Coordination and Humanitarian Supply-Chain Resilience in Nigeria. The data suggests that Automated Logistics Coordination has not yet developed into a cohesive independent resilience capability.

Automated Logistics Coordination exhibits a minor correlation with Visibility in the primary model, particularly at diminished visibility levels; nevertheless, this effect is tenuous and does not influence average Collaboration or Agility. The findings thus support a phased, human-centric digital transformation in which the Nigerian humanitarian sector initially enhances data quality, predictive capabilities, collective situational awareness, and decision-making integration, before subsequently broadening automation when process standards, interoperability, competencies, and governance are adequately established.

The results further substantiate the core tenet of Socio-Technical Systems Theory. Technology generates value when it is collaboratively refined alongside individuals, processes, organizations, and operational circumstances. In humanitarian settings, when mistakes can impact access to nourishment, housing, healthcare, and safety, this idea holds significant importance. The most robust future humanitarian framework in Nigeria will not be characterized by excessive automation. It will be characterized by automated tools that are reliable, interoperable, accountable, and intentionally combined with seasoned human judgment.

Future Research

Future research should be conducted out employing a larger sample. This would allow for more robust evaluations of minor Automated Logistics Coordination impacts and measurement consistency across different segments of the Nigerian humanitarian sector. Longitudinal designs are also needed to verify whether changes in Automated Logistics Coordination precede changes in visibility, collaboration and agility rather than occurring alongside them.

Future research could be conducted to focus on international humanitarian agencies, governmental agencies and NGOs in Nigeria to investigate the level of adoption of Automate logistics coordination and its impact on resilience.

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