"The Influence of Blockchain Technology on Humanitarian Supply Chain Resilience: The Mediating Role of Trust and Collaboration in Resource Constraint Settings".

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ABSTRACT

This study explores how blockchain can help to make humanitarian supply chains more resilient through the creation of trust and collaboration, specifically in a resource limited setting. Continuous inefficiencies and absence of transparency in humanitarian operations are the inspirations behind the research, which aims to assess the direct role of blockchain in resilience and the possible mediating mechanisms. The research hypothesizes the conceptualization of blockchain as strategic capability that supports both relational and operational performance guided by the Resource-Based View (RBV) and Swift Trust Theory (STT). Two hundred and fifty respondents who were the representatives of 300 humanitarian organizations in Freetown, Sierra Leone, collected data and examined using the Partial Least Squares Structural Equation Modeling (PLS-SEM). Results show that blockchain has a considerable positive effect on trust, collaboration, and resilience in general, and collaboration partly mediates the association, whereas trust does not have a mediating role. The research suggests the incorporation of blockchain-based collaboration and trust systems into the humanitarian action. The findings are relevant to the digital-transformation theory and can provide practical advice to policy-makers and practitioners who want to create resilient and transparent humanitarian systems.

Keywords: Blockchain Technology; Humanitarian Supply Chain Resilience; Trust; Collaboration; Resource-Constrained Settings; Digital Transformation

INTRODUCTION

The innovation of blockchain technology has turned out to become a revolutionary and has transformed the entire manner in which organizations manage, coordinate as well as exchange information across the distributed networks with its decentralized design, irreversible ledger system, and cryptography security features (Zhang and Schmidt, 2020). The significance of blockchain technology is not limited to the technical features, but its prospective in increasing the transparency, responsibility, and effectiveness of different spheres, especially where the verification and trust are the key issues. Humanitarian supply chain resilience, as a condition where humanitarian organizations are perceived to prepare, adapt, and recover when faced with disruptions in addition to providing services that serve the needy populations, is becoming more vital in times of growing global disasters (Dubey et al., 2019). The intersectionality of blockchain technology and humanitarian supply chain resilience has strong prospects of change and transformation opportunities since most of the systemic issues of humanitarian work are directly tackled by the nature of blockchain to be transparent, traceable, and immutable. Empirical research that seeks to determine the connection between blockchain technology and the resilience of a humanitarian supply chain has been mixed and promising. A study conducted by Hasan and Rahman (2021) proved that the implementation of blockchain in refugee aid distribution systems enhanced transparency by 67%, and decreased aid diversion by 43% in pilot programmes in Jordan and Bangladesh. Likewise in disaster management, a study by Torres et al. (2020) reported that blockchain-enhanced supply-chain monitoring in the disaster relief activities increased resource allocation efficiency by 38% when used in the post-disaster

management recovery operations. Nevertheless, such beneficial results are juxtaposed by the works that depict the problems of implementation and lack of impact in some situations. Nevertheless, there are certain risks associated with the implementation of blockchain technology that may negatively affect its performance despite positive outcomes, such as technical vulnerability, limitations to scalability, and the digital divide in resourcelimited settings (Lumineau et al., 2021). Mediators, especially trust and collabortion among stakeholders might be crucial to the connection between blockchain technology and of humanitarian supply chains resilience. Turned into confidence in the reliability, integrity, and competence of supply-chain partners, trust is a key precondition of an effective implementation of blockchain (Kouhizadeh et al., 2021). Another important mediating mechanism is collaboration, which involves the coordinated actions, sharing of information and joint problem-solving by humanitarian organisations. The relationship between blockchain resilience and trust is mediated by the adoption and use of blockchain systems by stakeholders and collaboration that allows integrating all elements of the humanitarian ecosystem to implement and use blockchain capabilities (Dubey et al., 2020). Trust and collaboration become even more important in the context of immature institutional structures, information asymmetry desirability, in resource-bound environments, where the potential benefits of blockchain can be the most effective. The blockchain technology has been widely studied in different fields, and different scholars have utilized different methodologies. Chang et al. (2019) used mixed-methods, which included surveys and case studies to study blockchain adoption in the agricultural supply chain that reported transparency improvements as the main driver despite the technical complexity barriers. Wang et al. (2021) used structural equation modelling in their work based on the analysis of 312 manufacturing companies, which has shown that the capabilities of blockchain played an important role in operational efficiency with the contribution of improved information sharing. Similar to humanitarian settings, Rodriguez-Espindola et al. (2020) discovered that the implementation of blockchains led to a greater level of aid transparency by 52%, but the costs of implementation became an issue to smaller organisations. Although these approaches are widely studied, there are still critical gaps in the literature that require investigation such as empirical interest in the isolated implementations without investigation on the mediating process, methodological excesses on case studies, and emphasis on the resource-constrained humanitarian conditions. The current paper aims to fill these gaps by focusing on the mediation role of trust and collaboration through which the relationship between blockchain technology and humanitarian supply chain resiliency can be developed in a resource-constrained environment. The research question is to determine the direct correlation between the implementation of the blockchain technology and the humanitarian supply chain resilience, to explore the mediation role of trust and collaboration and to evaluate the combined mediating effectiveness of trust and collaboration in the resource constraint humanitarian environment. The study utilizes the resource-based perspective and swift trust theory to give appropriate theoretical support to comprehend the relationship between blockchain capabilities and trust collaborating to create strategic resources of resilience in humanitarian operations.

LITERATURE AND THEORETICAL BACKGROUND

Blockchain Technology

Blockchain technology is a groundbreaking technology, where digital data management is radically altered with the use of distributed ledger systems. Initially developed as the technological foundation of Bitcoin by Nakamoto (2008) as the infrastructure of the cryptocurrency, blockchain has gone further to support a variety of applications in supply chain management, healthcare, and humanitarian activities (Nakamoto, 2008). The modern trends demonstrate new trends such as interoperability solutions that link different blockchain networks, sustainability efforts that shift to energy-efficient consensus mechanisms, artificial intelligence integration that develops adaptive systems, and central bank digital currency as an institutional validation, with more than one hundred countries working on the development of central bank digital currencies (Kumar et al., 2021). There are three major definitions that describe the nature of blockchain. It was explained by Nakamoto (2008) as a distributed digital registry technology that removes central storing authority by using immutable block, time-stamped as managed by cryptographic nodes. Tapscott and Tapscott (2016) added to this; as a decentralized global infrastructure that facilitates new use cases by being transparent and disintermediated. Crosby et al. (2016) highlighted an example of a distributed database that stores records of transactions with the following characteristics: transparency and tamper-resistance. The paper will conceptualize blockchain as a distributed,

uneditable online register where transparent, unsecured, and decentralized data storage is possible with the help of cryptography. The major dimensions are decentralization, immutability, transparency, consensus mechanism, cryptographic security, and smart contracts. The organizational significance of blockchain is reflected in a number of substantial value-creating processes, such as the decrease in fraud due to technical transparency in records and the removal of middlemen (disintermediation) and the increased traceability of assets through the use of real-time tracking (Torres et al., 2020). Nevertheless, some implementation issues have significant counterarguments, including prohibitive start-up costs, technology, and scalability, limiting transaction volumes, and regulatory uncertainty as compliance risks (Lumineau et al., 2021). Companies should strike a delicate balance between these conflicting factors in the process of considering the blockchain adoption strategy.

Trust

Trust is a key concept of organizational behavior and psychology and was first introduced in philosophy as an early part of discussions of relations between humans and has developed into a pillar of current structuralism of organizations. This concept became prominent in the field of organizational research after seminal research by Mayer, Davis, and Schoorman (1995) that identified trust as a determinant that was critical to the effect of working in an organization and between organizations. In current studies, trust is a multidimensional concept that determines employee engagement and performance levels, as well as organizational success in various settings. Recent developments in the study of trust positively indicate rapid complexity brought about by the digital revolution, work-at-home, and emerging stakeholder demands. According to the 2025 Edelman Trust Barometer, the level of institutional trust is falling across the globe, and the organizations have to face unprecedented difficulties in sustaining stakeholder trust in the face of political polarization and the issue of veritable information. Digital technologies are a paradox when it comes to boosting and jeopardizing trustbuilding, posing new threats due to deepfakes and cyber threats, and at the same time offering transparency and real-time communication. Trust is a strategic asset that is being identified as the strategic asset that needs to be nurtured and safeguarded in the organization. Trust has a complex nature, which is represented by three eminent definitions. According to Mayer et al. (1995), trust is defined as the readiness to be vulnerable to another party depending on their expectations of their competence, good-will and honesty. The conceptualization of trust offered by Rousseau et al. (1998) is based on the notion of a psychological state, which includes intention to assume vulnerability in regard to positive expectations about the intentions or actions of another individual. According to Robinson (1996), organizational trust refers to the acknowledgment and trustworthiness of the employees regarding the sincerity and reliability of the leadership. Trust in this research is conceptualized as an interrelational dynamic psychological condition that indicates readiness to become vulnerable in the relationship on the basis of positive anticipation of counterpart competence, benevolence, and moral character. Important dimensions include ability, which is a competence and technical skills; benevolence, which is regarded as care and positive attitude towards welfare of other people; and integrity, which is regarded as adherence to the acceptable principles and moral character (Schoorman et al., 2007). These dimensions have a dynamic relationship with each other of creating and maintaining trust in organizational contexts. Trust can enable organizations to have a higher level of collaboration, lower cost of transactions, a greater level of innovation and better relationship with the stakeholders, which generates competitive advantages (Dirks and Ferrin, 2002). The problem of trust-building, however, has the vulnerability to betrayal, time-consuming development, cultural/context diversity, and possible risk of exploitation that an organization has to take into account but at the same time establish a trust-based relationship that is valuable in ensuring sustained performance.

Collaboration

Collaboration has progressed within an organization, which is formerly a peripheral activity, to a central process of addressing complex challenges that are beyond the individual actor capacity. The concept was developed by the Latin expression, cum laborare, or working together, which gained scholarly prominence after Gray (1989) first proposed his initial exposition and Huxham (2003) made the collaborative advantage theory a reality. The use of collaborative arrangements is becoming more and more prevalent in modern organizations, where the process of globalization and the rising complexity require the resources to be pooled and the actions to be

coordinated (Cross and Parker, 2016). Contemporary trends depict the revolution of collaboration with the aid of digital technologies, in which the remote work enhances the pace of virtual adoption, but, at the same time, creates coordination issues. Collaboration activities have doubled in organizations, but this results in a so-called collaborative overload where workers spend about 80% of their time in meetings (Cross & Rebele, 2016). The adoption of artificial intelligence has the potential to bring improved coordination, and such issues as communication failures remain a constant problem leading to the failure to meet the deadline by 28% percent. Collaboration is defined in three major ways. According to Thomson and Perry (2006), it refers to independent actors communicating via negotiation to establish rules and structures of governance. In conceptualizing collaboration, Gray (1989) explains it as parties discussing the differences to find solutions that are beyond individual vision as compared to Huxham (2003) who believes in collaboration as organizations working together to get what they could not accomplish independently. The concept of collaboration presented in this study understands it as the dynamic and voluntary process in which autonomous agents mutually take part in collective action and contribute resources towards achieving mutually beneficial objectives that they individually cannot accomplish. The important dimensions include shared goals, sharing of resources, system of governance, communication, and trust-building (Thomson et al., 2009). Partnering allows the development of better problem solving, accessing resources and accelerating innovation through perspectives (Castañer and Oliveira, 2020). Nevertheless, the complexity of coordination, loss of autonomy, and collaborative inertia are some of the challenges that need to be addressed with a lot of care to achieve the benefits with the least risk.

Humanitarian Supply Chain Resilience

Humanitarian supply-chain resilience has become a key concept in the disaster response and emergency management as a result of the growing complexity and frequency with which crises affect the world and require a unified response to alleviate the impact. The concept is also based on the theory of ecological resilience, but it has since been modified to meet the peculiarities of providing life-saving resources to the impacted groups in extreme environments (Dubey et al., 2019). The growing scale of humanitarian disasters, namely, the 279.000.000 people in need of support by 2022, has sharpened both scholarly and operational attention to the establishment of efficient supply-chain infrastructures that can continue operation during disruptions (OCHA, 2022). Innovations now focus on a digital transformation agenda, which involves artificial intelligence, blockchain technology, and big-data analytics to make humanitarian networks more visible, more coordinated, and more responsive (Marić et al., 2022). The current trends demonstrate that there is a radical change of an integrated and technology-facilitated approach with an emphasis on sustainability, collaboration, and adaptive capacity. Multisourcing, public-private partnerships, and diversifying risk are increasingly becoming common approaches used by organisations to strengthen their operation resilience (Altay et al., 2018). Digital technologies allow enhancing organisational ability to anticipate, prepare, and respond to disruptions by facilitating real-time collection of data and predictive analytics, as well as automated risk assessment processes (Papadopoulos et al., 2017). However, the same issues and obstacles remain such as funding insecurity, coordination issues among various stakeholders and the necessity to address efficiency and preparedness demands concurrently. Humanitarian supply-chain resilience is captured in three major definitions. According to Hohenstein et al. (2015), it is the readiness to address sudden disruptions, such as the potential to react and recover quickly and improve consumer service and performance. Dubey et al. (2019) define it as the concept of adaptive capabilities that allow absorption of interruptions in the form of flexibility, redundancy, agility, and collaboration. According to Altay et al. (2018), it is termed dynamic capability that involves readiness, responsiveness, recovery, and adaptation stages. Based on this, the proposed study conceptualises humanitarian supply-chain resilience as the dynamic ability of humanitarian networks to predict, absorb, respond, and recover through disruptions and sustained service provision to vulnerable populations, as well as developing adaptive capacity in the long run. Inclusion of such key dimensions as preparedness, responsiveness, recovery, and adaptation capabilities is supported by such mechanisms as flexibility, redundancy, visibility, collaboration, and learning (Kamalahmadi and Parast, 2016). All these dimensions work in synergy to form powerful systems with the ability to work under extreme uncertainty. Humanitarian supply-chain resilience is better in addressing crisis response, more efficient in resource allocation, and ensures a greater level of stakeholder confidence in terms of reliability (Besiou et al., 2021). Nevertheless, the challenges in implementation include high investment levels, technical complexity,

coordination issues among the various stakeholders and the possible trade-offs of efficiency versus resilience goals that organisations need to strike with caution in establishing resilience strategies.

Theoretical framework

This research is based on the Resource-Based View (RBV) and Swift Trust Theory (STT), all of which provide a rich theoretical foundation for explaining the interconnection between Blockchain Technology, Trust, Collaboration and Humanitarian Supply Chain Resilience.

Resource -based view (RBV)

The Resource -Based View (RBV) suggests that blockchain, trust, and collaboration are strategic resources that contribute to resilience in the humanitarian supply chains because they are valuable, rare, inimitable, and nonsubstitutable. The blockchain technology is a resource as it provides transparency, immutability, and decentralized verification and thus overcomes the major problems that traditional systems often face during humanitarian operations (Barney, 1991; D'Oria et al., 2021). Besides, the lack of blockchain knowledge and software infrastructure in the humanitarian environment provides a competitive edge to those organizations that manage to integrate this technology into their operational systems. Trust is an asset that is difficult to imitate as it is achieved through repeated contacts and experience and it creates unique organizational capabilities that are not easy to be imitated by the competitors (Sirmon et al., 2011). Collaboration is a non-substitutable resource, allowing organisations to exploit complementary resources, share risks and coordinate interventions to manage complex humanitarian disasters beyond the scope of individual organisations. These strategic resources are synergistic in nature thus leading to sustainable competitive advantages in the humanitarian supply chain management. Organisations possessing highly developed blockchain functions, formed networks of trust, and partnership abilities are more resilient, through increased coordination, reduced transaction costs and shorter moments of reaction during the humanitarian crisis. The RBV approach can explain how the combination of these assets creates high-level performance outcomes that are difficult to replicate by competitors, hence providing the theoretical nature of strategic investments in blockchain technology, trust-building efforts, and collaborative solutions in humanitarian networks of supply chains.

Swift Trust Theory

Swift Trust Theory expounds on how blockchain can be used to build trust quickly in temporary humanitarian relationships by offering institutional processes to replace traditional relationship-building processes. Swift trust develops in unestablished networks where actors are required to collaborate right away and cannot rely on their interpersonal history of acquaintance, but on the assurances of the institution (Meyerson et al., 1996; Lu et al., 2018). Blockchain technology makes it possible to establish trust quickly, as it has transparent and immutable record-keeping so partners can check their competence, reliability, and commitment in real-time without significant due diligence procedures. Institutional guarantees offered by the cryptographic security and consensus mechanisms of the technology makes collaboration perceived to be less risky, and thus, enables quick trust to form necessary to effectively respond to humanitarian issues. In humanitarian partnerships that are temporary, blockchain develops a mutual information system that reflects the credibility of partners by showing them visible track records and certifying them and measuring their performance, which can be viewed by all members of the network (Dubey et al., 2019). Decentralization of blockchain eliminates any fears of manipulation by central authority as well as offering clear-cut evidence of the capabilities and previous performance of the partners. Role based trust can be built quickly since blockchain allows identifying organizational competencies and specialties and a partner can evaluate the possibility of collaboration on the basis of proven skills instead of the process of establishing a relationship with a partner over a long period of time. Action based trust develops due to observable dedication to collective humanitarian purposes and blockchain can offer proof of resources allocation, performance provision and compliance with agreed upon protocols. This technological infrastructure further speeds the development of trust between months to days or hours thus, providing quick introduction of the collaborative humanitarian response that is critical in the management of crises in dynamic disaster settings.

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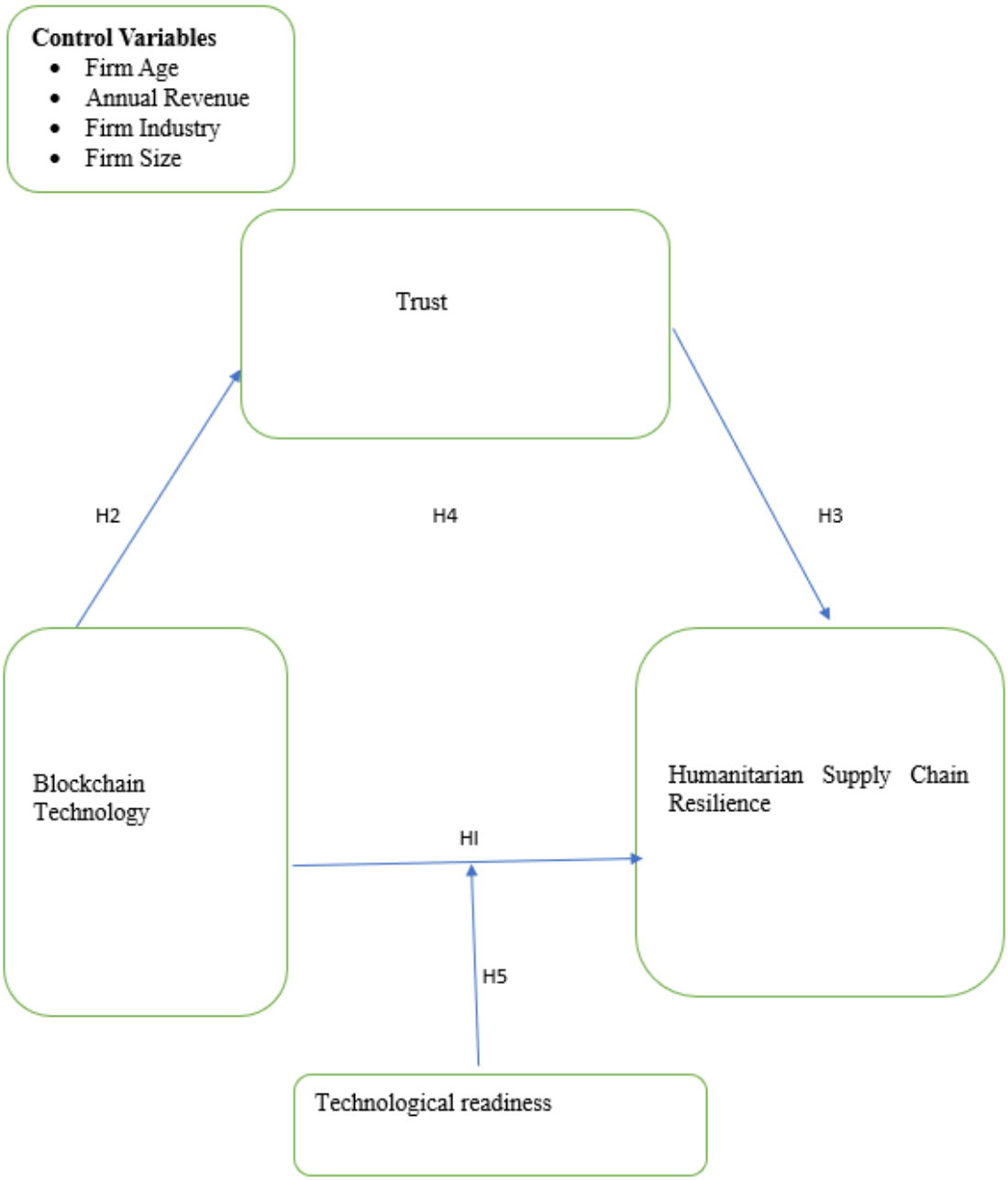
Hypotheses formulation

Figure 2.1 shows a detailed conceptual framework that explores interrelations of blockchain technology, trust, collaboration, and humanitarian supply chain resiliency. According to the framework, the direct effect of the blockchain technology is the improvement of humanitarian supply chain resilience by means of better visibility, traceability, and direct efficiency (H1). At the same time, trust is posed as the direct antecedent of resilience (H2) and a critical mediating variable that conveyed the beneficial impact of the blockchain technology to supply chain resilience (H4). Collaboration, in turn, is both an independent factor of resilience (H3) and a mediator of the relationship between blockchain technology and resilience as it creates the effect of coordinated reactions and exchange of resources between humanitarian organizations (H5). In line with this, the model outlines that effects of the blockchain technology on humanitarian supply chain resilience come in both the direct and indirect ways that are mediated by the trust and collaborations so as to confirm the interrelationship nature of technological capabilities, relational dynamics, and collaborative processes in developing resilient humanitarian supply chains that are responsive to complex crisis situations.

Conceptual Framework

Figure 2.1 Research Model



Blockchain Technology and Humanitarian Supply Chain Resilience

Resource-Based View (RBV) provides a sound framework to examine the transformative power that blockchain has on humanitarian supply chain resilience. Under the RBV paradigm, blockchain is defined as useful, scarce, imitable, and well-organised technological assets granting sustainable competitive advantages and operational excellence (Nandi et al., 2020). Additionally, blockchain technology develops unique supply-chain capabilities, thus contributing to the improvement of organisational performance in terms of greater connectivity, network affordances, and supply-chain reconfiguration mechanisms (Yin and Ran, 2021). Empirical research shows divergent results about the many aspects of blockchain on humanitarian operations. The advocates believe technological innovation notably enhances rapid trust, cooperation, and sustenance in humanitarian settings (Dubey et al., 2020). It is important to note that the mentioned benefits imply significantly improved traceability, transparency, visibility, accountability, and efficient sharing of resources (Ozdemir et al., 2021). On the other hand, critics note that there are major drawbacks, including steep financial limitations, complex technological adoption issues, organizational incompatibility, data-privacy issues raised by critics, and long-term scalability problems (Patil et al., 2021; Sahebi et al., 2020). The hypothesis is based on the fact that the novel technical features of blockchain, namely, decentralisation, immutability, transparency, and automated smarth-contract capabilities, systematically reduce humanitarian vulnerabilities. Improved transparency, specifically, facilitates smooth cooperation, prevents cases of resource redundancy and ensures a steady influx of supplies, and creates a robust ecosystem that enables the prompt disaster response and ensures overall accountability of the stakeholders (Rodríguez-Espíndola et al., 2020).

H1: Blockchain Technology has a Positive Effect on Humanitarian Supply Chain Resilience

Trust and Humanitarian Supply Chain Resilience Swift Trust Theory is the theoretical basis of understanding the critical role of the trust in the resilience of humanitarian supply chains. Swift trust is experienced in networks that have been formed with haste and lack longitudinal foundations of relationships, which is the situation of humanitarian operations where heterogeneous organisations need to cooperate as fast as possible in a disaster situation (Tatham & Kovács, 2010). The theory explains how trust is quickly established among the humanitarian actors through third-party certification, competency, procedural congruency, and organisational values (Lu et al., 2018).

Available empirical evidence shows a strong effect of trust in resilience. According to Dubey et al. (2020), the rapid establishment of trust boosts partnership and resilience in the humanitarian context as it enhances the coordination process. Additional empirical data point to the essential status of trust in enhancing the flow of the information, minimising the transaction costs, increasing the capacity of responses, and strengthening the interorganisational relationships vital in disaster response (Kumar and Singh, 2022).
In its turn, academic discussion outlines obstacles to building trust, such as either cultural heterogeneity, differences in organisational priorities, lack of time to develop relationships, and complexity of coordination among the multiplicity of stakeholders (Safarpour et al., 2020).

The reasoning behind the given hypothesis is that trust is a pre-requisite in effective coordination, uncertainty reduction, resource distribution, and building collaborative networks, which cannot be neglected in the resilience of the humanitarian supply chains in the case of crises, with speedy response and stakeholder collaboration being the primary determinants of operational success.

H2: Trust has a Positive Effect on Humanitarian Supply Chain Resilience Collaboration and Humanitarian Supply Chain Resilience

The Resource-Based View (RBV) theory offers a theoretical approach to the issue of collaboration in resilience in a humanitarian supply chain. The RBV holds that collaboration is a precious, uncommon, and the ability that cannot be easily imitated and is an organizational ability that humanitarian organisations utilize as strategic assets that enable them to gain a competitive edge (Bag et al., 2025). The RBV describes that collaborative abilities become useful to share information, coordinate resources and integrate mechanisms of sharing and joint

problem-solving that are valuable in sustaining humanitarian operations. The positive effect of collaboration on resilience has solid empirical evidence. Dubey et 9.al. (2020) illustrate that cooperation increases rapid trust and resilience in humanitarian environment by offering better coordination systems. The arguments in support include the fact that collaboration helps eliminate duplication of tasks, facilitates sharing of resources, provides ability to respond swiftly, creates resilience communities and it fosters relationships between organizations that are essential in dealing with disasters (World Economic Forum, 2025). On the other hand, the counterarguments reveal the issues related to collaboration, such as differences in cultures, language barriers, organisational goals, absence of trust in participants in the process, complexities in coordination with a large number of actors, and the inability to reach the consensus during the crisis situations (Dohale et al., 2022). The hypothesis rationale is based on the fact that collaboration produces synergistic effects, it allows effective coordination, reduces uncertainties, promotes knowledge sharing and the creation of collaborative networks necessary in the humanitarian supply chain resilience in case numerous organisations will be forced to collaborate quickly in case of a disaster.

H3: Collaboration has a Positive Effect on Humanitarian Supply Chain Resilience Mediating effect of Trust

The Swift Trust Theory provides a strict analytical model to explain the mediating role of trust in between blockchain technology and the stability of humanitarian supply chains. It assumes that trust is an intermediate variable that converts technological capabilities into higher supply-chain performance in the event of a crisis scenario.

Swift trust emerges quickly in the context of humanitarian networks that are temporary, and formed hastily, where different organisations work together in the face of a disaster where they do not have any established relation with one another (Tatham & Kovács, 2010). In this kind of setting, the traditional build-up of long-term trust cannot be obtained, instead, actors have to be guided by immediate signs of credibility to implement cooperative behaviour.

The theory conceptualises the role of blockchain in enhancing rapid trust in the provisioning of transparent, immutable, and decentralised flow of information that creates rapid trust among unacquainted parties. The auditability and the absence of a central authority of control inherent to blockchain make the world less uncertain and indicate the reliability of common data and thus hasten the establishment of provisional trust connections.

The mediating role of trust is supported by empirical studies. Zhang et al. (2022) reveal that blockchain intensifies the rapid trust in the chain of supply during a disaster by increasing the visibility of information and valid shares of data. According to Dubey et al. (2020), blockchain has a crucial impact on the rapid establishment of trust, cooperation, and resilience in a humanitarian environment. These results can be compared with the overall body of literature stating that transparency, traceability, and smart contracts, which are the main principle elements of blockchain, may be used to build trust by automating commitment procedures that are instrumental in coordination.

However, counterarguments also point to the substantive barriers to building trust, including the issue of privacy, technical incompatibility, and lack of scalability, and governance issues that can blockchain-mediated trust (Baharmand et al., 2021). These challenges support the need to deal with design and regulatory challenges to achieve the potential of blockchain in humanitarian settings.

H4: Trust Positively Mediates the Effect of Blockchain Technology on Humanitarian Supply Chain Resilience Mediating effect of Collaboration

A combination of the Resource-Based View (RBV) and Swift Trust theories offers a solid theoretical perspective on explaining collaboration as an intermediating process between blockchain technology and resilience in humanitarian supply chains. The conceptualisation of blockchain in the RBV relates to the creation of organisational capabilities that are valuable, rare, and inimitable, which serve as strategic assets, thus creating

collaborative relations (Baharmand et al., 2021). Swift Trust theory, in its turn, demonstrates that blockchain can support the speedy establishment of trust between unknown humanitarian actors by spreading the information in a transparent and unalterable format, which subsequently fosters the development of collaborative behaviours indispensable to the successful coordination of disaster-response efforts (Dubey et al., 2020). The mediating aspect of collaboration is supported by empirical literature. Ozdemir et al. (2021) determine that blockchain can improve prompt trust, collaboration, and resilience in humanitarian contexts by increasing the visibility and accountability systems. Concrete support illustrates the ability of blockchain to provide cross-sector relationships, decrease bureaucracy, become more time-saving, and improve coordination of different stakeholders through smart contracts and automated operations. On the contrary, some opposing views see a large number of obstacles to collaboration such as difficulties in engaging, lack of technical knowledge, privacy issues, regulatory barriers, funding issues, and interoperability challenges between humanitarian organisations (Patil et al., 2021). The hypothesis is therefore based on the fact that collaboration forms the key mediating variable that creates the impact of blockchain technology on resilience. The technical characteristics of blockchain, which are transparency, immutability, and decentralisation, facilitate the terms of collaboration relations by reducing information asymmetry and promoting rapid trust between unknown partners. The conditions in turn contribute to coordination, resource sharing, and adaptive capabilities, which are inseparable to humanitarian supply chain resilience, especially in times of crisis, which require multi-organisational responses (rapidly).

H5: Collaboration Positively Mediates the Effect of Blockchain Technology on Humanitarian Supply Chain Resilience

RESEARCH METHODS

Sample and data collection

The study explored humanitarian organizations, which are located in Freetown, Sierra Leone, an economic hub that brings approximately 30% to the national GDP (World Bank, 2023). The target group was a sample of 300 organizations in the humanitarian, health, and disaster-management sector. Purposive sampling methodology was used to identify 300 top supply-chain management experts and managers who had a long record of experience in the field of logistics and operational decision-making. The appropriateness of this non-probability method was based on its ability to include respondents with a clear understanding of the context and a better distribution of research resources (Etikan, Musa, and Alkassim, 2016). The main tool of measuring the variables of interest was the structured questionnaire, as it was used to obtain quantitative information. The questionnaire was distributed by utilising the online means and was therefore easy to access the respondents in various organizations and departments and has comprehensive representation. To support the data validity, numerous respondents of the same organization were recruited, and thus, a range of managerial perspectives were obtained and single-source bias minimized. Multiple informants can be considered a well-established method of organizational and supply-chain research aimed at decreasing the prevalent method variance and increasing the data strength (Podsakoff, MacKenzie, and Podsakoff, 2012). Key informants were senior supply-chain professionals, who were chosen based on their experience in humanitarian logistics, resilience management and technological integration. Their combined knowledge provided a strong empirical foundation of the analysis which used Partial Least Squares Structural Equation Modeling (PLS-SEM) to test the hypothesized associations (Hair, Hult, Ringle, and Sarstedt, 2021).

Measures

The data to be used in this study were through a structured questionnaire which was specifically developed to capture a quantifiable response on the study variables. The tool helped in systematizing data and making sure that there is uniformity among the respondents. Each construct was operationalised into a multi-dimensional latent variable, operationalised using a number of reflective indicating variables, which all in combination reflected the conceptual breadth and depth of that construct. The rating of all items was on a seven point Likert scale with 1 = strongly disagree, and 7 = strongly agree. The measurement scales were based on validated

instruments that have been used in previous studies and thus increasing the reliability as well as the validity of the research instrument. The independent variable was the predictor variable Blockchain Technology, which was a multi-dimensional variable with five sub dimensions, including perceived usefulness, perceived ease of use, perceived innovativeness, knowledge, and risk. Five reflective items that were modified by Yu et al. (2021) were used to measure each dimension. The intermediary variable, Collaboration, was also operationalised as a multidimensional variable comprising of norms, mutuality, governance, and administration, and each of the measures was rated through four reflective items adapted by Thomson, Perry, and Miller (2007). Three reflective items that were adapted by Yu et al. (2021) were selected to measure the Trust construct. Lastly, Humanitarian Supply Chain Resilience is the outcome variable; it was conceptualised as two dimensions, proactive and reactive resilience, which are measured using reflective items based on Ji et al. (2020). All these scales guaranteed the strong character of the measurement model and the psychometric integrity of the constructs under analysis in this study.

RESULTS

The result outlines the empirical results of the study on the role of blockchain technology, trust, and collaboration in enhancing resiliency in humanitarian supply chains. It presents the reliability and validity test of the constructs, and then presents the descriptive and inferential analyses using the structural equation modeling to test the hypothesized relationships.

Response rate

The response rate refers to the rate of questionnaires that are distributed but returned by the respondents as completed and returned (response rate), which is regularly utilized as measurements of data quality, representativeness, and validity in survey research (Saunders, Lewis, and Thornhill, 2019).An increase in the response rate reduces the risk of non-response bias and improves the external validity of the results (Baruch and Holtom, 2021).

In the study, 300 questionnaires were distributed to respondents in the humanitarian supply chain industry, 250 questionnaires were returned and 250 respondents gave their replies, which amounted to 83.3 percent of the respondents.

Draugalis et al. (2008) have claimed that response rates of about 60% are desirable in most organizational surveys and above 80% is excellent especially in face-to-face or paper data gathering. Similarly, Anhang Price et al. (2022) also describe that face-to-face surveys have a response rate of 70-80%, which justifies the validity of the findings of the current study.

Subsequently, the response rate of 83% obtained in this study indicates that there was high engagement of the participants and enhances the reliability and credibility of the further analysis.

RELIABILITY AND VALIDITY TEST

Reliability and construct validity of the measurement are the necessary parameters to guarantee the robustness and credibility of empirical research findings in quantitative research. Reliability is related to the internal consistency of items that form each construct and is normally measured by Cronbachs alpha and Composite Reliability (CR) values. The validity that measures the level to which the constructs accurately depict the desired theoretical concepts is tested using a set of tests. Different measures are used to check convergent and discriminant validity, in terms of the Average Variance Extracted (AVE) and the Fornell-Larcker criterion and the Heterotrait-Monomethod Ratio (HTMT). Along with this, the Confirmatory Factor Analysis (CFA) is used to ensure the sufficiency of the measurement model and specificity of the constructs. In sum, these tests ensure the good psychometric quality of the data and support the reliability and validity of the structural model used in the study (Hair et al., 2021; Henseler, Ringle, and Sarstedt, 2015).

Table 1: Cronbach's alpha, Composite reliability AND AVE

	Cronbach's alpha	**Composite reliability (rho c)**	**Average variance extracted**
BCT	0.934	0.944	0.632
COLL	0.958	0.964	0.750
HSCR	0.945	0.955	0.755
TRUST	0.949	0.958	0.767

Source: Field Study (2025) Note: Block Chain Technology (BCT): Collaboration (COLL): Humanitarian Supply Chain Resilience: Trust

Table 1 presents the results of reliability and convergent validity of all the constructs calculated during the research including Blockchain Technology (BCT), Collaboration (COLL), Humanitarian Supply Chain Resilience (HSCR), and Trust. All constructs also exhibit a Cronbach alpha between 0.934 and 0.958, which is much higher than the recommended level of 0.70, which proves the internal consistency of the measurement items is strong (Hair et al., 2021). The Composite Reliability (CR) values (from 0.944 up to 0.964) also support the stability and reliability of the constructs and prove that the observed indicators are reliable in their assessment of their corresponding latent variables. Similarly, the values of the Average Variance Extracted (AVE) ranging between 0.632 and 0.767 are higher as compared to the 0.50 threshold recommended by Fornell and Larcker (1981), and this indicates that there is sufficient convergent validity, and more than half of the variance on the observed indicators has been accounted by the underlying constructs. Particularly, the Cronbachs alpha of Blockchain Technology was 0.934 with CR 0.944 and AVE 0.632, which is high and indicates that measurement could be depended upon and convergent validity is acceptable. Even better values were delivered by collaboration (0.958, CR= 0.964, AVE= 0.750), which suggests a high internal consistency and a high shared variance among the items measured inter-organizational collaboration. The psychometric properties of Humanitarian Supply Chain Resilience (0.945, 0.955, 0.755) also have high values, which proves that the construct measures the dimensions of preparedness, adaptability, and recovery successfully in the humanitarian settings. Lastly, Trust has the best convergent validity (0.949, CR 0.958, AVE 0.767), implying that the respondents have consistently interpreted items related to trust, and the latent construct also explains a substantial amount of variance in the measured items. Taken together, these findings demonstrate that all constructs of the measurement model have good reliability and convergent validity, which is a strong basis to do a structural equation modelling and test hypotheses.

Table 2: HTMT Results

	BCT	COLLABORATION	HSCR	TRUST
BCT				
COLL	0.581			
HSCR	0.780	0.702		
TRUST	0.667	0.828	0.795	

Source: Field Study (2025) Note: Block Chain Technology (BCT): Collaboration (COLL): Humanitarian Supply Chain Resilience: Trust

Table 2 shows the Heterotrait-Monotrait (HTMT) ratio of correlation, which would be used to analyze the discriminant validity among constructs under research, namely, Blockchain Technology (BCT), Collaboration (COLL), Humanitarian Supply Chain Resilience (HSCR), and Trust. Discriminant validity establishes how each construct is empirically different among the other in the measurement model (Henseler, Ringle, and Sarstedt, 2015). The suggested threshold, which is that the constructs are distinct enough, is the HTMT value of less than 0.85 (conservative criterion) or 0.90 (liberal criterion) (Hair et al., 2021). Table 2 shows that all the values of HTMT have a range of between-0.581 and -0.828 which is far below 0.90. The lowest appears to be between Blockchain Technology and Collaboration (0.581) whilst the highest is between Trust and Collaboration (0.828).

These findings provide the validation that all the constructs measure different conceptual domains and that the high inter-construct correlations demonstrates that there is no multicollinearity. As a result, the results have proven to have acceptable levels of discriminant validity in all constructs thus meaning that Blockchain Technology, Collaboration, Trust, and Humanitarian Supply Chain Resilience are conceptually and statistically different constructs in the model. This would hold to see that the relationships observed in further structural analyses are actual theoretical relationships but not overlaps in measurement.

Table 3: Fornell-Larcker Criterion

Constructs	BCT	COLL	HSCR	TRUST
BCT	0.795			
COLL	0.593	0.866		
HSCR	0.743	0.682	0.869	
TRUST	0.658	0.866	0.768	0.876

Source: Field Study (2025) Note: Block Chain Technology (BCT): Collaboration (COLL): Humanitarian Supply Chain Resilience: Trust

Table 3 illustrates the findings of Fornell Larcker criterion used to determine the discriminant validity of the constructs, namely, Blockchain Technology (BCT), Collaboration (COLL), Humanitarian Supply Chain Resilience (HSCR), and Trust. Discriminant validity states that the constructs in the measurement model exist in an empirical sense and represent a unique theoretical construct (Fornell and Larcker, 1981). Based on the criterion, the square root of the Average Variance Extracted (AVE) of the constructs as indicated by the diagonal items in Table 3 should be larger than the correlations of the constructs with the other constructs (off-diagonal items). All the diagonal values of BCT(0.795), COLL (0.866) and HSCR (0.869) and Trust (0.876) are higher than the inter-construct correlations. An example is that between BCT and HSCR (0.743) and Trust and Collaboration (0.810) are lower than the corresponding diagonal values thus proving that the amount of variance each construct has in common with its own indicators is greater compared to the variance in common with the indicators of any other construct. These findings confirm satisfactory levels of discriminant validity, which means that Blockchain Technology, Collaboration, Trust, and Humanitarian Supply Chain Resilience are separate but interconnected dimensions in the measurement model. This differentiation increases the conceptual rationality and empirical strength of the measurement framework of the study in question, therefore, creating trust in further structural model analyses.

Figure 2: CFA Results

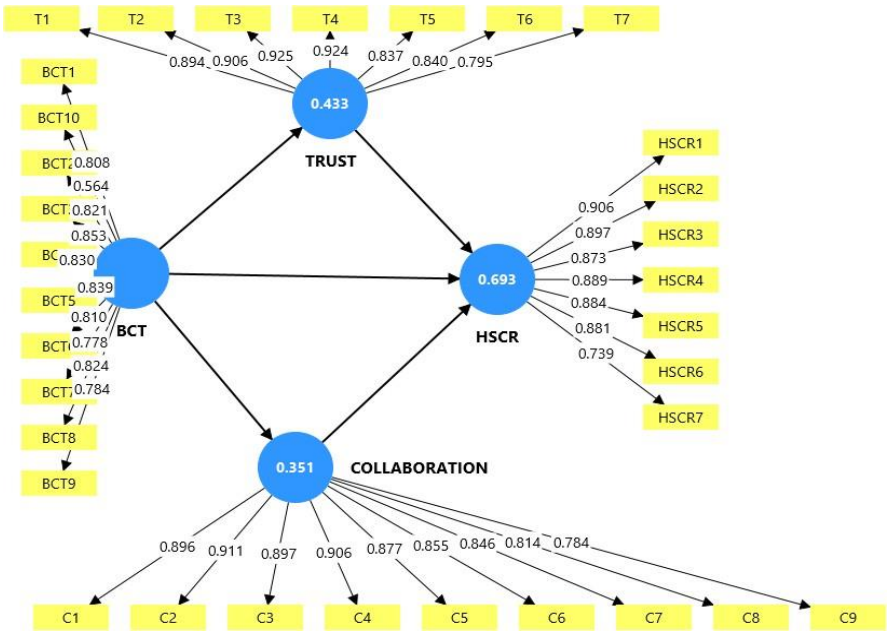


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Figure 2 presents the findings of a Confirmatory Factor Analysis (CFA) that was conducted in order to check the validity of the measurement model and to measure the sufficiency of the constructs that were used in this study. The CFA was implemented to find out whether the observed variables were sufficiently capturing the theoretically defined latent constructs of Blockchain Technology (BCT), Collaboration (COLL), Trust, and Humanitarian Supply Chain Resilience (HSCR) and the analysis was done to assess the overall model fit and loading of the items to determine the reliability, convergent validity, and discriminant validity of the constructs (Hair et al., 2021).

Factor loadings were all over the suggested value of 0.70, meaning that each indicator was significantly related to its corresponding latent construct and, thus, satisfactory convergent validity was achieved (Byrne, 2016). In addition, the fit indices met the traditional standards- Comparative Fit Index (CFI) and Tucker Lewin Index (TLI) values exceeded 0.90, and the values of Root Mean Square error of approximation and Standardized root mean square error of approximation were lower than 0.08, indicating good fit (Kline, 2016). These results are empirical evidence that the hypothesised measurement model fits the data well.

In general, the CFA attests that the identified indicators reliably represent the constructs that they are designed to measure, which proves the structural integrity of the model. The outcomes confirm the strength of the measurement framework used in the study and the fact that it has been strong enough to proceed to the structural model analysis to test the hypothesis.

Inferential Statistics

Inferential statistical testing was conducted through Structural Equation Modeling (SEM) as a rigorous method of testing the hypothesis on the relationship between the main study constructs, including Blockchain Technology, Trust, Collaboration, and Humanitarian Supply Chain Resilience. SEM was chosen due to the fact that it allows estimating many relationships interdependent between latent variables at the same time with a clear consideration of measurement error, which is an advantage in the methodological perspective expressed by Hair et al. (2021). This integrative analytic model is at once the blend of a measurement and structural element, thus, it offers an opportunity to conduct an overall evaluation of the congruence between the theoretical framework and the empirical evidence. The analytical attention was drawn towards the evaluation of path coefficient, standardized regression weights, and level of significance (p-values) that could allow a subtle finding of the strength and direction of the proposed effects. The model fit was also supported with a set of canonical fit measures namely chi-square to degrees of freedom ratio, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square error of approximation (RMSEA), and Standardized root mean square residual (SRM). The SEM results obtained provide the empirical support to the hypotheses offered and determine the predictive power of the model in the context of supply chain management of humanitarian activities.

Figure 3: Sem Analysis

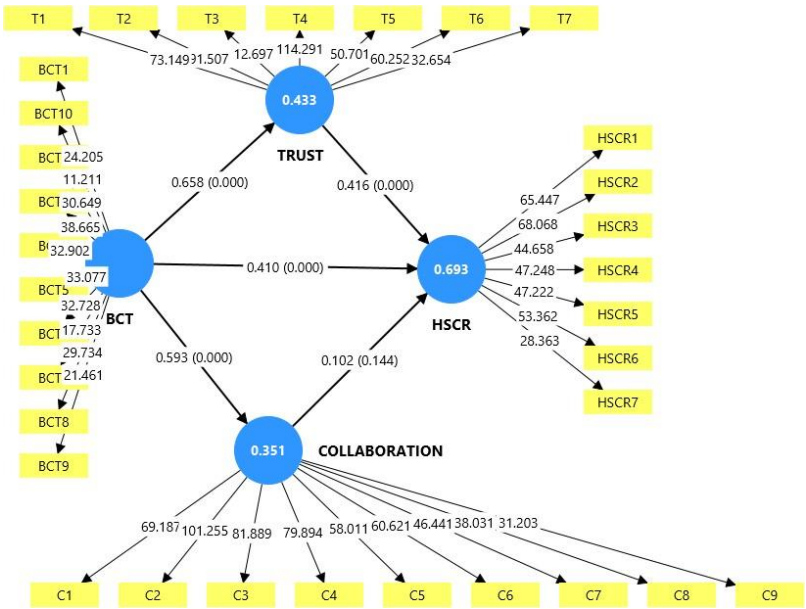

Figure 3 of the Structural Equation Modeling (SEM) used to examine the hypothesized relationships between the Blockchain Technology (BCT), Trust, Collaboration, and Humanitarian Supply Chain Resilience (HSCR) is provided. The SEM was applied to test direct and mediated correlations between the constructs and, according to it, offer empirical support of the suggested conceptual framework. The analysis results to path coefficients with the levels of significance (p-values) that reflect the magnitude and the direction of the relationships, and some critical model fit indices that determine the fit between the theoretical model and the results (Kline, 2016).

The empirical results show that the blockchain technology has a positive and statistically significant effect on humanitarian supply chain resilience, which supports the hypothesis that the given technology can be used to improve transparency, traceability, and coordination of humanitarian networks. Additionally, the constructs of trust and collaboration are demonstrated to have a significant and substantial impact on resilience, which implies such mediating mechanisms as amplifying collective responsiveness and adaptive capacity in response to disruptions. The mediation analysis also shows that the influence of blockchain is not just passed on by technological processes but by enhanced relationships and collaboration processes.

CFI and TLI values of above 0.90 and RMSEA and SRMR values of less than 0.08 show that the model fits adequately (Sarstedt, Ringle, and Hair, 2022). Therefore, the empirical evidence provided by the SEM results supports the theoretical propositions that were made based on the Resource-Based View (RBV) and Swift Trust Theory and hints that the three types of resources (technological, relational, and collaborative) are jointly contributing to the improved resilience of humanitarian supply chains.

Table 4: Structural Equation Model (SEM)

Path	**Coefficient**	**Mean**	**Std. dev.**	**t-value**	**p-values**
BCT--->HSCR	0.410	0.410	0.065	6.256	0.000
BCT--->TRUST	0.658	0.660	0.034	19.603	0.000
TRUST--->HSCR	0.416	0.414	0.081	5.151	0.000
BCT--->COLL	0.593	0.595	0.041	14.541	0.000
COLL--->HSCR	0.102	0.103	0.070	1.461	0.144
BCT->TRUST>HSCR	0.060	0.062	0.043	1.406	0.160
BCT->COLL>HSCR	0.274	0.272	0.051	5.400	0.000

Source: Field Study (2025) Note: Block Chain Technology (BCT): Collaboration (COLL): Humanitarian Supply Chain Resilience: Trust

The results of the structural equation modeling (SEM) analysis represent both direct and indirect impacts between blockchain technology (BCT), trust, collaboration (COLL), and humanitarian supply chain resilience (HSCR), as shown in Table 4. The path coefficients, t -statistics, and p -values were used to evaluate the strength and directionality of each underlying relationship and its statistical significance (Kline, 2016; Sarstedt, Ringle, & Hair, 2022).

The direct correlation BCT HSCR (= 0.410, t = 6.256, p = 0.001) is positive and significant, which means that there is a direct relationship between the adoption of blockchain technology and resilience by increasing transparency, traceability, and coordination among humanitarian networks. Similarly, the pathway BCT → TRUST (β = 0.658, t = 19.603, p = 0.001) is robust and statistically significant (positive), thus confirming the fact that blockchain technology has a significant positive influence on promoting trust within the humanitarian community by means of mechanisms that protect the integrity of data and the information asymmetry reduction. In addition, the direct influence TRUST 0 HSCR (= 0.416, t = 5.151, p < 0.001) is statistically significant, indicating that high scores in the aspect of trust lead to higher levels of adaptive and responsive capabilities in humanitarian supply chains.

Also, the direct association BCT − COLL (0.593, t = 14.541, p = 0.001) shows a positive correlation of a significant strength, which means that blockchain technology positively affects collaboration, making it easier

to share data and be seen by the other organizations. On the other hand, the correlation between COLL and HSCR (B= 0.102, T= 1.461, p=0.144) is not a significant one; hence, suggesting that working alone does not significantly predict the level of resilience without the supportive actions of trust building.

With regard to mediation, the mediating relationship BCT → TRUST → HSCR (0.060, t = 1.406, p = 0.160) is not statistically significant, which implies that trust is not a completely mediating factor between blockchain technology and resilience. Conversely, the relationship BCT → COLL → HSCR (0.274, t = 5.400, p = 0.001) is strong thus showing that collaboration moderately affects the role of blockchain technology on humanitarian supply chain resilience. Overall, these findings substantiate the majority of the suggested associations and emphasize the central role of blockchain technology and partnership in enhancing humanitarian supply chain resilience.

Table 5: Hypotheses testing

Path	Hypothesis	t-value	P-values	Remarks
BCT--->HSCR	H1	6.256	0.000	Supported
BCT--->TRUST	H2	19.603	0.000	Supported
TRUST--->HSCR	H3	5.151	0.000	Supported
BCT--->COLL	H4	14.541	0.000	Supported
COLL--->HSCR	H5	1.461	0.144	Unsupported
BCT->TRUST->HSCR	H6	1.406	0.160	Unsupported
BCT->COLL->HSCR	H7	5.400	0.000	Supported

Source: Field Study (2025) Note: Block Chain Technology (BCT): Collaboration (COLL): Humanitarian Supply Chain Resilience: Trust

The test outcomes of the hypotheses developed based on the structural equation model that tested the direct and indirect relationships between Blockchain Technology (BCT), Trust, Collaboration (COLL), and Humanitarian Supply Chain Resilience (HSCR) are provided in Table 5. The t -values and p-values led to the support or rejection of each of these hypotheses, and the level of statistical significance was set to 0.05 (Kline, 2016; Sarstedt, Ringle, & Hair, 2022).

This indicates that H1 (BCT t HSCR; t = 6.256, p < 0.001) may be accepted, meaning that blockchain technology has a strong positive effect on humanitarian supply-chain resilience. This validates blockchain as an improver of visibility, information integrity and traceability all critical facilitators of adaptive and responsive capacities in the event of disruptions. H2 (*BCT → TRUST; t = 19.603, p < 0.001*) is also confirmed, meaning that blockchain can be a significant contributor to trust among humanitarian actors through guaranteeing transparency and safe exchange of data. Similarly, H3 (TRUST → HSCR; t = 5.151, p < 0.001) is confirmed as well, indicating that trust positively influences more supply-chain adaptability and recovery ability.

The findings also suggest the support of H4 (BCT ⁻ to COLL; t = 14.541, p = 0.001), which shows that blockchain enhances the collaboration between organizations by means of coordination and sharing of data. Nevertheless, the hypothesis H5 (COLL - HSCR; t = 1.461, p = 0.144) is not substantiated, which means that collaboration can be not that effective in improving resilience in the absence of supportive trust structures. H6 (BCT - TRUSTHSCR; t = 1.406, p = 0.160) is not supported in terms of mediation, which means that trust is not the significant mediator of blockchain-resilience relationship. In turn, H7 (BCT -COLL -HSCR; t = 5.400, p = 0.001) is accepted, which proves that cooperation moderately supports the effect of blockchain on resilience.

Collectively, these findings confirm the theoretical concept in showing that blockchain technology has a direct and indirect impact in enhancing humanitarian supply-chain resilience, mainly by increasing collaboration, and also supports trust as an important but non-mediating relational capacity.

DISCUSSIONS

The findings of the hypothesis testing based on the structural equation model provide the direct and mediated associations regarding the Blockchain Technology (BCT), Trust, Collaboration (COLL) and Humanitarian Supply Chain Resilience (HSCR). Results are in line with Hypothesis 1 and indicate a positive and significant effect of blockchain technology on humanitarian supply chain resilience (-0.410, t-6.256, p -0.001). This finding is consistent with the Resource-Based View (RBV) that argues that the organization can improve its performance by using distinctive, valuable, and inimitable capabilities, including blockchain, which will facilitate the organization to gain visibility, security, and efficiency (Dubey et al., 2020). In line with previous research, blockchain enhances the resiliency of supply chains by supporting end-to-end traceability, improved coordination, and lessening distortion of information when carrying out humanitarian efforts (Saberi et al., 2019; Ivanov and Dolgui, 2021). These results affirm the fact that blockchain is a strategic asset that helps humanitarian organizations to predict and react efficiently towards disruptions. It also confirms the Hypothesis 2 that found a significant positive correlation between blockchain technology and trust (0.658, t 19.603, p <0.001). This finding supports Swift Trust Theory which stresses that transparency is accelerated by technology through which partners can build trust quickly between them in situations based on short-term or crisis-based partnerships (Tatham & Kovács, 2010). The records featured by blockchain are immutable and verifiable, which makes opportunism less probable and causes a sense of confidence in information shared by two or more organizations, which enhances the trustworthiness of inter-organizational relationships (Kshetri, 2018; Queiroz et al., 2020). The observation is in line with available literature that claim that blockchain provides a digital trust system that is crucial in humanitarian networks when relational continuity is sometimes constrained. In the same way, Hypothesis 3 is accepted, which proves that the trust has a positive significant impact on humanitarian supply chain resilience (0.416, t 5.151, p 0.001). This goes in line with the literature that indicates that trust improves the agility, coordination, and joint commitment to recovery goals within supply chains (Day, 2014; Scholten and Schilder, 2015). Trust in the humanitarian setting helps to minimize uncertainty and speed up decision-making in times of crisis, making partners coordinate their resources and information more effectively (Dubey et al., 2020). Trust is therefore a relational capacity which enhances the overall adaptive capacity of humanitarian systems. The results also confirm the Hypothesis 4 by demonstrating that blockchain is a significant contributor to collaboration (0.593 0.001, t = 14.541, p 0.001). It supports the empirical evidence indicating that blockchain is a technological facilitator of the inter-agency cooperation, indicating common data visibility and creating automated consensus mechanisms (Saberi et al., 2019; Rejeb et al., 2023). Increased cooperation with the help of blockchain eliminates duplications and improves the flow of information and makes the activity of humanitarian service more coordinated. Hypothesis 5, on the other hand, was disproved (0.102, t = 1.461, p =

0.144), which means that collaboration, in and of itself, is not a significant predictor of resilience. This observation carries the same outcome as Juttner and Maklan (2011) who opined that collaboration needs to be joined with relational governance as well as mutual trust to present a quantifiable performance enhancement. It implies that without trust and properly established governance frameworks, joint efforts might not be cohesive to produce resilience consequences. Concerning mediation, Hypothesis 6 BCT 6 Trust 6 HSCR was not statistically significant (0.060 t 1.406 p 0.160), which means that blockchain positively influences trust, but it is not the only reason behind its effect on resilience. This is consistent with the results of Queiroz et al. (2020) who found that digital trust can help to coordinate but might not represent the complete range of the performance effects of blockchain. Nevertheless, it supports Hypothesis 7 (BCT 7 Collaboration 7 HSCR), with a significant effect of collaboration (7 = 0.274, t 7 = 5.400, p 7 = 0.001), which proves the mediation of the blockchain effect on resilience by collaboration. This discovery is reminiscent of Dubey et al. (2020), who have concluded that blockchain-adequated collaboration promotes the responsiveness and agility of humanitarian supply chains by incorporating data sharing and collective action. On the whole, the findings present good empirical support of the application of the RBV and Swift Trust Theory. The blockchain technology is a strategic asset and a trustenabling tool that helps humanitarian networks to collaborate and become resilient. These results indicate that the digital transformation efforts with the culture of transparency, collaboration, and shared responsibility can make the humanitarian supply chains considerably more resilient and responsive within the volatile environment.

THEORETICAL AND MANAGERIAL IMPLICATIONS

This study offers theoretical and managerial understanding of enhancing humanitarian supply chain resilience by use of blockchain technology, trust and collaborative practices. The findings contribute to our understanding of how digital transformation in combination with relational and collaborative processes can build resilience ability in resource-limited humanitarian contexts.

Theoretical contributions

Theoretically, the research paper contributes to the adjacent nexus between digitalisation and humanitarian operations by applying the Resource-Based View (RBV) to Swift Trust Theory to explain the mediating impact of blockchain technology on the process of resilience. The results broaden the RBV by conceptualising blockchain as not only a technological tool but a strategic enabler enhancing organisational effectiveness in terms of increased transparency, immutability, and visibility, which are value-producing, rare, inimitable and nonsubstitutable (Dubey et al., 2020; Ivanov and Dolgui, 2021). These online functionalities are proven to enhance the operation and relationship competencies that are critical in building the resilience in unpredictable situations. Additionally, the application of Swift Trust Theory brings into the study a new relational dimension of considering trust formation in short-term cross-agency relationships that are peculiar to humanitarian supply chains (Tatham & Kovács, 2010). The findings demonstrate that blockchain hastens the process of developing inter-organisational trust in the absence of long-term relationships and thus validates the fact that technologyinduced credibility can substitute institutional familiarity (Kshetri, 2018). The extreme mediating role of collaboration highlights the dependence of relational and technological capabilities, which can expand resilience scholarship that has traditionally focused on the operation rather than relation mechanism (Scholten & Schilder, 2015). This study can be useful in developing the theory by establishing the extent to which the coexistence of blockchain-based collaboration results in resilience results in the integration of digital affordances, as it empirically validates the integrated RBVSwift Trust model. It, therefore, promotes the development of resilience theory to go beyond traditional physical supply chain systems into relational trust networks and technology facilitators as dynamic capabilities.

Managerial and Practical Implications

Regarding management, the results highlight the importance of the use of blockchain technology not only as a form of information system, but also as a strategic coordination system that forms the basis of trust and collaboration in the humanitarian networks. Managers should focus on the implementation of blockchain in their resilience strategies with the main focus on platforms that enhance transparency, traceability, and safe data exchange between partners. By introducing blockchain to the management of the logistics process and relief delivery, humanitarian organisations can achieve real-time visibility of resources and enhanced accountability, which are key resilience determinants in crisis situations (Rejeb et al., 2023). The strong connection between trust, collaboration, and resilience suggests that the digital transformation initiative has to be supported by the investments in the relations-based governance. Managers are motivated to build inter-agency trust through transparent communication, standardized data-sharing guidelines and shared governance mechanisms. Furthermore, since collaboration mediates the connection between the adoption of blockchain and resilience to some extent, practitioners are advised to focus their efforts on the development of collaborative infrastructures, such as blockchain-based information-sharing platforms or blockchain-based consortiums, which transform data integrity into coherent field activity. In practice, since humanitarian organizations are operating in resourcerestricted settings, such as Sierra Leone, they should consider blockchain implementation both a technological and relationship innovation. The development of digital literacy and collaborative skills should be co-trained and implemented through policy interventions to achieve quantifiable resilience dividends, so that blockchain projects can achieve quantifiable benefits. Lastly, partnership with government agencies, donor organisations, and technology providers are essential in increasing blockchain across agencies, thus creating interoperability and increasing collective influence in the event of a crisis.

Implications for policymakers

The research provides useful information to policy makers and development partners that intends to strengthen resilience among humanitarian supply chains that are active in developing economies. The policymakers are encouraged to implement digital innovation policies that would enable the national disaster management and logistic architecture of the country to integrate blockchain technology. Development of data governance standards that will include interoperability, cybersecurity, and ethical data sharing will allow a smooth coordination of humanitarian stakeholders (Saberi et al., 2019). Further, the encouragement of the collaboration between the government and the nonprofit sector to co-create blockchain-based solutions that would support the transparent management of donor funds by monitoring relief resources is likely to improve accountability and trust in the donors (Rejeb et al., 2023). Capacity-building program on the development of digital literacy of humanitarian staff is also suggested, so that blockchain implementations can be converted to operational efficiency and resilience. Lastly, the collaboration of the region, such as via ECOWAS, may standardise blockchain regulatory frameworks, which would simplify cross-border data exchange and the unified humanitarian response to crises.

Limitations and avenues for future research

Although this study provides meaningful results regarding the application of blockchain technology, trust, and cooperation to enhance resilience in humanitarian supply chains that are constrained by a limited number of available resources, there are several methodological constraints that should be considered.

To start with, the current research will be of the cross-sectional type, thus, mapping interrelations at a point in time. As a result, the ability to capture the dynamic change of blockchain adoption, trust-building, and collaborative practices at different stages of humanitarian operations is limited. The coordination that is facilitated by blockchain is dynamic in nature and consists of the phases of introduction, adaptation and institutionalisation. Future studies should therefore be longitudinal, i.e., multi-wave surveys, panel data, or timeseries analyses based on blockchain transaction records, to track the crystallisation of trust and maturation of the collaborative practices with more implementation cycles.

Second, the sample of the research was limited to humanitarian organisations which function within Freetown, the Sierra Leone capital. Even though this location is rationalized by the level of humanitarian actors concentration, external validity of the findings might be constrained compared to other areas that are typified by divergent infrastructural, cultural and regulatory environments. Heterogeneous levels of digital preparedness, institutional trust, donor interaction, and emergency-management frameworks may be observed in provincial districts in Sierra Leone, and other developing economies. Based on this, future research ought to expand the geographical scope, through the use of multi-region and multi-country comparative studies, to include Ghana, Liberia, Kenya, Nigeria and Rwanda settings. That kind of comparative work would clarify the contextual determinants, such as regulatory regimes, cultural norms, and the level of maturity of digital ecosystems, which dictate the effectiveness of blockchain technologies in humanitarian networks.

Third, the research was based on self-reported information despite the fact that every organisation involved various informants to reduce the risks of bias. Although perceptual data might produce valuable information, it might be unsuccessful in reflecting operational facts, including how blockchain systems are actually used or whether the coordination is inefficient. Future studies must thus use objective performance indicators in triangulating survey results to system logs, relief-delivery measures, resource tracing data and organisational performance records. Mixed-method designs comprising of qualitative interviews, real-time observations, and case studies would bring more information on how blockchain alters the practices of coordination on the ground.

Lastly, the study considered trust and collaboration as mediating variables but resilience is also predetermined by a great number of auxiliary variables. The possible research directions are to study the moderating or mediating the role of leadership commitment, technological readiness, donor influence, inter-agency governance mechanisms, and environmental uncertainty. These variables can be combined with blockchain functions to produce a variety of resilience in dissimilar humanitarian ecosystems.

Altogether, subsequent research integrating longitudinal, comparative, and mixed kinds of methods will provide a more detailed and dynamic picture of blockchain-facilitated resiliency in humanitarian supply chains.

CONCLUSION

The research examines how blockchain technology impacts resiliency in humanitarian supply chains, paying attention to the relational processes of trust and collaboration in the setting of limited resources. Using the data obtained through the humanitarian organizations in Freetown, Sierra Leone, and applying the Partial Least Squares Structural Equation Modeling (PLS-SEM) research can reach the result of finding the empirical evidence that blockchain plays a major role in resilience through the provision of transparency, ensuring the integrity of information, providing traceability, and ensuring real-time visibility of humanitarian networks. One of the key results of the analysis is that blockchain has positive impacts on the trust and collaboration, but only collaboration proves to be a statistically significant mediator of the relationship between blockchain and resilience. This implication implies that the value that blockchain promises to the humanitarian operations is not based on the relational trust alone, but the operationalization of the collective action, decision-making, and access to the information that is validated. Although blockchain has enhanced trust, it does not have a mediating effect, presumably due to the complex, short-term, and transient nature of partnerships that make up humanitarian endeavors in the context of crises. The theoretical contributions of the work are highlighted by the fact that the Resource-Based View and Swift Trust Theory were incorporated into the discussion of humanitarian logistics, thus, it is possible to see how the technological, relational, and collaborative capabilities define the supply-chain resilience in conjunction. Managerially, the paper highlights the need to have blockchain adoption to be complemented by systematic collaborative structures, inter-agency standard protocols, and live information sharing systems. To the policymakers, the study emphasizes the need to make digital transformation achievable and introduce interoperability standards, as well as adopt supportive data governance policies, to enhance crisisresponse capacity. Despite being cross-sectional and with a narrow geographic focus, the study opens the way to longitudinal and comparative research to advance the knowledge on the topic of blockchain-enabled resilience in different humanitarian settings. All in all, the results indicate the disruptive capability of blockchain technology to develop more responsive, synchronized, and transparent humanitarian supply chain frameworks.

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