Journal of Sustainable Development of Transport and Logistics
journal home page: https://jsdtl.sciview.net

Nyile, E. K., Shale, N. I., & Osoro, A. (2025). Optimizing humanitarian aid in Kenya: The synergy between lean-agile supply chains and organizational characteristics. *Journal of Sustainable Development of Transport and Logistics, 10*(1), 152-177. doi:10.14254/jsdtl.2025.10-1.10.

ISSN 2520-2979

Optimizing humanitarian aid in Kenya: The synergy between lean-agile supply chains and organizational characteristics

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Article history:

Received: October 30, 2024
1st Revision: February 28, 2025
Accepted: May 15, 2025

DOI:
10.14254/jsdtl.2025.10-1.10

Abstract: This study examines the implementation of lean-agile (leagile) supply chain strategies in Kenyan humanitarian organizations, assessing their impact on operational performance with organizational characteristics as moderators. A census survey of 330 humanitarian aid organizations in Kenya was conducted, achieving an 87.88% response rate (290 organizations). Using moderated multiple regression and Grey Incidence Analysis, the research tested five hypotheses linking supply chain responsiveness, resilience, efficiency, integration, and organizational characteristics to performance outcomes. Results revealed that leagile dimensions collectively explain 71.9% of performance variance (R^2=0.719), with responsiveness (β=0.532), efficiency (β=0.415), and integration (β=0.458) showing strong positive effects. Organizational characteristics—size, structure, and age—moderated these relationships, increasing the explanatory power to 82.7% (R^2 = 0.827). The study validates Grey Incidence Analysis as a robust framework for managing uncertainties in humanitarian "grey systems" and integrates organizational theory into supply chain leagility research. Practically, it advocates for full leagile adoption, emphasizing decentralized decision-making, AI-driven forecasting, and technologies like IoT and blockchain to enhance coordination and resilience. Despite high donor funding, Kenya's Arid and Semi-Arid Lands (ASALs) face persistent inefficiencies, underscoring the need for localized capacity-building and multi-stakeholder collaboration. Limitations include reliance on self-reported data and a cross-sectional design, suggesting future longitudinal studies and beneficiary feedback integration. This work contributes empirical evidence on hybrid supply chain strategies in humanitarian contexts, offering actionable insights for

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policymakers and practitioners to optimize disaster response in resource-constrained environments.

Keywords: humanitarian supply chain, leagile supply chain, humanitarian organization performance, organizational characteristics, grey system theory, disaster response, supply chain integration.

Sustainable Development Goals (SDGs): SDG 1: No Poverty; **SDG 2:** Zero Hunger; **SDG 3:** Good Health and Well-being; **SDG 9:** Industry, Innovation and Infrastructure; **SDG 10:** Reduced Inequality; **SDG 17:** Partnerships for the Goals

1. Introduction

Humanitarian organizations are diverse, each with distinct structures, operational methods, communication strategies, and decision-making processes. Responding rapidly and appropriately to humanitarian disasters requires intricate coordination, as these efforts are vital to saving lives and alleviating suffering. Emergency responses must be timely, effective, appropriate and well-organized, with supply chain management playing a central role. The success of humanitarian programs relies heavily on the ability of supply chain professionals to procure, transport, receive, and distribute supplies efficiently at the site of relief efforts (Rashid, 2018). Humanitarian supply chain professionals face the dual challenge of designing effective supply chains that meet the needs of vulnerable populations while satisfying the expectations of donors and funders amid a rising number of global humanitarian disasters. Humanitarian supply chain management involves planning, implementing, and controlling the systematic movement and storage of goods, materials, and information from origin to the point of consumption, with the aim of alleviating the suffering of affected populations. This supply chain encompasses various processes, including alertness, strategy, acquisition, transportation, warehousing, customs clearance, and data analysis (Khan, Yong, & Han, 2019). It also ensures that humanitarian organizations are not exploited during emergency procurement processes.

Globally, supply chain experts are continually exploring innovative methods to develop efficient designs that can adapt to the rapidly changing circumstances of disasters. A widely adopted strategy in humanitarian supply chains is the implementation of leagile principles (Datta, 2017). The leagile supply chain blends lean and agile paradigms by positioning the decoupling point to manage inconsistent downstream demand while maintaining stable upstream production (Nayak & Choudhary, 2020). Lean principles, rooted in Toyota's production system, focus on minimizing waste and maximizing value by integrating administrative operations within and beyond organizations (Mostafa & Dumrak, 2017; Bortolotti et al., 2016). These principles emphasize creating value, eliminating waste, and generating efficient flow (Biazzo, Panizzolo & Crescenzo, 2016). Conversely, agility, evolving from flexible manufacturing systems, emphasizes organizational responsiveness by integrating suppliers, processes, and customers to adapt to changing demands (Abdi et al., 2018). Initially focused on reducing time wastage and adjusting product mix and volume, agility has since expanded to broader business contexts (Mangan, Lalwani & Lalwani, 2016).

While lean and agile approaches have individually enhanced supply chains, the hybrid Leagile strategy addresses volatility and uncertainty in contexts such as humanitarian relief. This strategy balances lean efficiency and agile responsiveness by strategically overlapping their processes at the decoupling point, optimizing supply chain effectiveness and efficiency (Shafiq et al., 2021). Companies seeking to reduce inefficiencies and gain a competitive advantage often adopt lean and agile paradigms. Lean practices focus on cost reduction and minimizing waste, benefiting high-volume, low-variety operations. Agile supply chains, however, prioritize flexibility, enabling organizations to adapt swiftly to unexpected changes in sourcing, logistics, and distribution (Christopher, 2016).

The lean paradigm functions optimally in predictable demand scenarios, relying on accurate forecasts and eliminating all forms of waste to gain a competitive edge in quality and cost. In contrast, humanitarian supply chains manage a diverse range of essential items for aid recipients, often encountering losses due to theft, misappropriation, inadequate tracking, and product deterioration (Mohammed, 2018). Agility, a broader concept, requires organizational participation, logistical

coordination, and advanced information systems (Christopher, 2016). Agile supply chains enable organizations to respond effectively to fluctuating customer demands and volatile market conditions. Key features of leagile supply chains include resilience, integration, and flexibility. Flexibility, as defined by Abdelilah et al. (2018), refers to adaptability and versatility, while agility emphasizes speed, making flexibility a prerequisite for agility. Supply chains play a crucial role in mitigating the impacts of disasters by delivering essential items and ensuring smooth recovery operations (Banikoi et al., 2018).

The lean approach emphasizes doing more with less while maintaining user satisfaction, as highlighted by Cockton, Lárusdóttir, Gregory, and Cajander (2016). Christopher (2016) emphasizes that a firm's success depends on striking a balance between customer needs and operational efficiency. Traditionally focused on cost minimization, modern supply chains now prioritize resilience—the ability to adapt to sudden disruptions and mitigate adverse impacts (Dufour et al., 2018).

The integration of lean and agile paradigms has driven industries to upgrade systems for improved performance (Christopher, 2016). Leagility combines features of both paradigms to form a robust strategy, offering efficiency and adaptability. Initially seen as distinct, leanness and agility are now often combined to enhance the performance of humanitarian supply chains (Dufour et al., 2018). Leagility ensures efficient resource utilization, reduced response times, and resilience, enabling reliable operations tailored to disaster types and magnitudes (Gitonga, 2021). Collaboration, skilled staff, and robust IT infrastructure are essential to achieving the humanitarian objectives of saving lives, alleviating suffering, and maintaining human dignity (Mokua & Kimutai, 2019).

1.1. Statement of the problem

The preparedness and capability of humanitarian aid organizations to act in the face of disasters and maintain proper supply chain coordination are moot (Shareef, Dwivedi, Mahmud, Wright, Rahman, Kizgin, & Rana, 2019). This concern arises due to the increasing number of emergencies, which puts pressure on humanitarian aid organizations to deliver aid in an effective manner (Olaogbebikan & Oloruntoba, 2017). The ASALs (vulnerable to hazards) of Kenya comprise more than 80% of Kenya's landmass, supporting nearly 30% of the total human population (Njoka *et al.*, 2016). About 70% of the disasters in Kenya are hydro-meteorological, particularly droughts, floods, and disease outbreaks, among others. This requires responsive and robust humanitarian supply chains to deliver aid promptly to vulnerable populations, given substantial donor funding (Njoka *et al*., 2016). Despite the substantial amount of money invested in the humanitarian sector, stringent oversight by donors, and high expectations from vulnerable populations, humanitarian supply chains still respond in a sluggish, inefficient, and poorly coordinated manner to emergencies (Paul, 2019). Notably, approximately 80% of disaster and relief operations are related to supply chains (Maghsoudi, Zailani, Ramayah, & Pazirandeh, 2018).

This study aimed to bring efficacy into the humanitarian sector by examining the concept of supply chain agility. Primarily, the concept was discussed in the context of commercial supply chains (Fadaki, Rahman, & Chan, 2019), and only a few academics and practitioners have linked supply chain leagility to humanitarian operations (Kuria and Chirchir, 2014; Purvis *et al.*, 2016; Koori and Chirchir, 2017). Qamar and Hall (2018) found that the two paradigms of lean and agility are mutually exclusive, whereas Purvis et al. (2016) described them as complementary concepts that need to be in balance, as both strive for an effective organization and create maximum value for its clients. The concept of supply chain leagility has been globally accepted (Galankashi & Helmi, 2016). Several humanitarian aid organizations have adopted leagility design, despite its limited documentation, to enhance the efficacy of their supply chains (Ponnusamy, 2019). Concisely, the application of the leagility concept is still immature, and a comprehensive overview of the concept is scarce. Previously, the lean and agile paradigms have been studied separately, with dominance on the agile side (rapid response) in humanitarian operations. This inclination towards agile processes and effectiveness procedures negated the need for lean processes and efficiency procedures, creating an observable gap in leagility (efficacy) and highlighting the need to study lean and agile paradigms as complementary and mutually supportive of each other. This, therefore, creates a gap for a specific study that focuses exclusively on supply chain leagility. This study aimed to fill the gap in the literature by researching supply chain leagility and the performance of humanitarian aid organizations in Kenya.

1.2. Objectives of the study

a) To examine the influence of supply chain responsiveness on the performance of humanitarian aid organizations in Kenya.
b) To establish the influence of supply chain resilience on the performance of humanitarian aid organizations in Kenya.
c) To determine the influence of supply chain efficiency on the performance of humanitarian aid organizations in Kenya.
d) To examine the influence of supply chain integration on the performance of humanitarian aid organizations in Kenya.
e) To determine the moderating effect of organizational characteristics on the relationship between supply chain responsiveness, supply chain resilience, supply chain efficiency, supply chain integration, and performance of humanitarian aid organizations in Kenya.

1.3. Research hypotheses

$H_0$1: Supply chain responsiveness does not significantly influence the performance of humanitarian aid organizations in Kenya.

$H_0$2: Supply chain resilience does not significantly influence the performance of humanitarian aid organizations in Kenya.

$H_0$3: Supply chain efficiency does not significantly influence the performance of humanitarian aid organizations in Kenya.

$H_0$4: Supply chain integration does not significantly influence the performance of humanitarian aid organizations in Kenya.

$H_0$5: Organizational characteristics do not have a moderating effect on the relationship between supply chain responsiveness, supply chain resilience, supply chain efficiency, supply chain integration, and the performance of humanitarian aid organizations in Kenya.

2. Theoretical framework

A theory can be explained as a set of interlinked concepts, definitions, and propositions that present a systematic view of a phenomenon through the specification of interactions among variables for the purposes of explanation and prediction of phenomena (Creswell & Creswell, 2017). The study was anchored on the Grey Incidence Analysis Model.

2.1. Grey incidence analysis model

Grey Relational Analysis (GRA), also known as Deng's Grey Incidence Analysis model, was introduced by Julong Deng in 1982. It is a key method within grey system theory, which addresses problems involving uncertainties and incomplete information. GRA categorizes information as black (no information), white (complete information), or grey (partial or uncertain information) (Yang et al., 2014). In grey systems, "grey" signifies weak, ambiguous, or insufficient information (Deng, 1982). Such systems include both known and unknown elements (Zheng & Lewis, 1993). The humanitarian sector is viewed as a grey system due to the unpredictable nature of its operations, where rapid and effective responses are critical.

Humanitarian supply chains face uncertainties about when and how disasters will occur, their nature, and magnitude. This unpredictability situates disaster response planning within the realm of grey systems. Grey numbers allow flexibility in judgment and decision-making under uncertainty, making them applicable in evaluating factors such as the disaster's nature, magnitude, location, infrastructure damage, available resources, and the number of victims. Initially, these elements are unclear and only become apparent over time. The grey analysis provides a framework for deriving solutions by evaluating partial information, offering a range of potential solutions rather than a singular resolution.

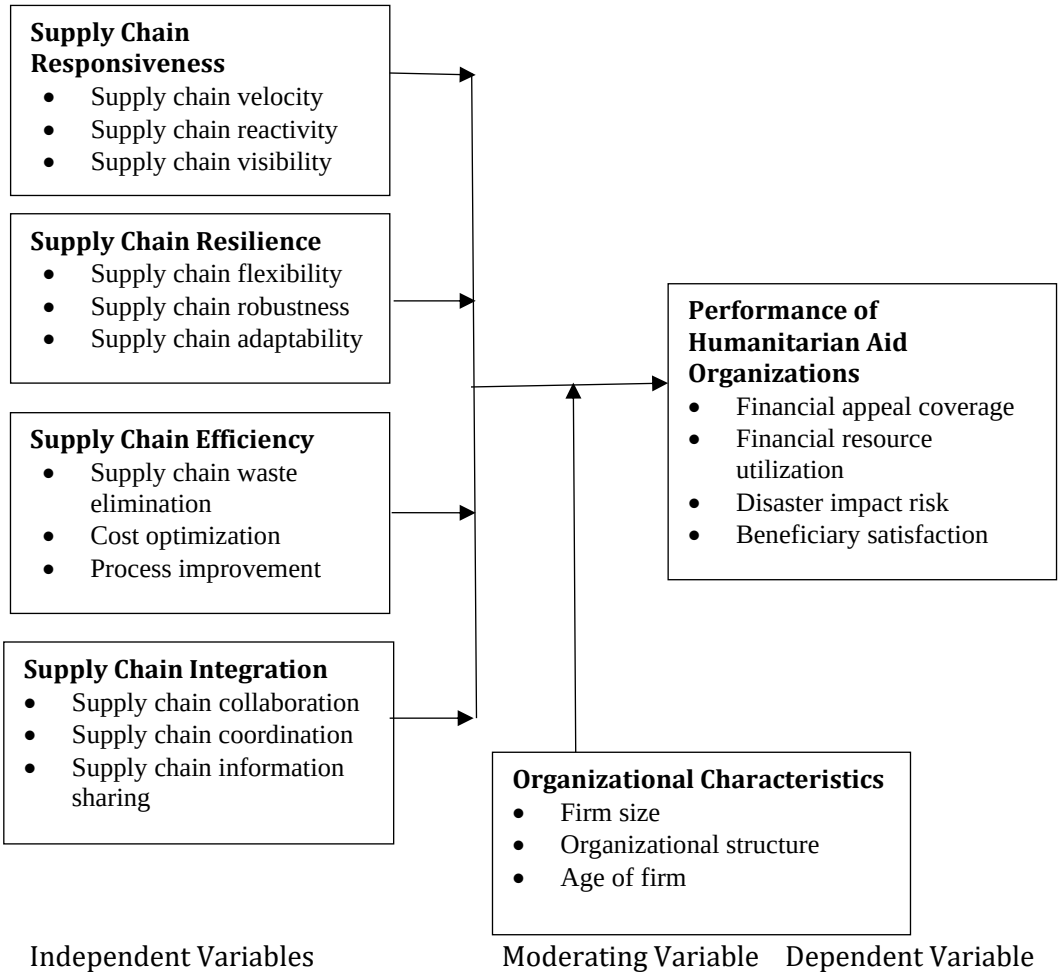
In the humanitarian context, grey systems align well with supply chain leagility —a hybrid strategy that combines leanness and agility to create more responsive and resilient supply chains. This

integration is essential in addressing volatile and uncertain environments, as noted by Bendul, Rosca, and Pivovarova (2017). Leagile supply chains enhance efficiency and adaptability, which are crucial for effective disaster response. GRA has become a widely applied model in humanitarian supply chains. Mwangi and Senelwa (2020) utilized GRA in their study on logistical factors influencing disaster responsiveness in Kenyan humanitarian organizations, emphasizing its importance in evaluating and improving humanitarian operations to save lives efficiently.

2.2. Conceptual framework

This study aimed to establish the influence of supply chain responsiveness, supply chain resilience, supply chain efficiency, and supply chain integration on the performance of humanitarian aid organizations in Kenya, with organizational characteristics serving as the moderating variable.

Figure 1: Conceptual framework



2.3. Supply chain responsiveness

Brusset and Teller (2017) define responsiveness in supply chains as comprising three key capabilities: velocity, reactivity, and visibility. Reactivity refers to the capacity to assess and respond quickly, while velocity is the ability to meet needs rapidly (Brusset & Teller, 2017). Visibility, as Vernon elaborates in Brusset and Teller (2017), involves tracking supply chain movements, including the identity, position, and status of shipments, along with specific dates and times for critical events. Together, adaptability, viability, and responsiveness form the foundation of the agile strategy, as highlighted by Brusset and Teller (2017). Agility is crucial for organizations requiring dynamic and flexible supply chains, making it especially relevant for humanitarian organizations. However, challenges such as limited resources and funding may complicate implementation. Nonetheless, supply

chain strategies from business settings can offer valuable insights. Focusing on supply chain management can lead to cost savings and increased client satisfaction, making it an appealing option for humanitarian entities, despite the short duration of relief operations (Chavez, Yu, Feng, & Wiengarten, 2016).

Agile manufacturing emerged as a reference point in the early 1990s, with supply chain management gaining prominence by the mid-1990s (Elbert et al., 2018). Agile manufacturing emphasizes strategic alliances and partnerships to achieve speed and flexibility, while supply chain management focuses on cost efficiency and the integration of suppliers and clients to create a seamless value chain (Elbert et al., 2018). Today, companies face the dual challenge of meeting customer demands for quality and affordability while responding to unique and rapidly changing requirements. Merging the strengths of agile manufacturing and supply chain management has led to the development of a responsive supply chain strategy (Elbert et al., 2018).

Christopher (2016) argues that supply chains must meet the needs of both enterprises and customers. Order-fill accuracy is essential; incomplete or inaccurate orders waste resources and risk customer loss. Scalability is another critical factor, allowing supply chains to adjust to fluctuations in sales volumes. Client satisfaction is central to responsiveness.

The increasing media coverage of disasters underscores the critical role of rapid response in humanitarian operations. Timely aid delivery is vital for survival, emphasizing that speed is often more important than cost in disaster relief. Guidelines often emphasize the importance of taking immediate and effective actions to save lives and alleviate suffering.

2.4. Supply chain resilience

Resilience is a multifaceted, dynamic capability that enables entities to integrate, build, and reconfigure internal and external competencies to sustain enterprise performance (Eltantawy, 2016). In supply chains, resilience allows systems to recover to their original state or transition to a more desirable state following a disruption (Adobor & McMullen, 2018). Organizational resilience is the ability to endure and thrive during crises and disturbances (Fisher, 2017). Kamalahmadi and Parast (2016) emphasize that supply chain resilience is closely linked to activities such as crisis management and business continuity planning.

The growing focus on resilience by researchers and policymakers stems from increasing vulnerabilities and disruptions. These are caused by external factors, such as legislative and environmental challenges, as well as internal factors, including financial status and process vulnerabilities (Krishnan & Pertheban, 2017). Resilience is driven primarily by disruption, which may stem from internal firm processes (process and control risks), internal supply chain networks (demand and supply risks), or external factors (environmental risks) (Abdel-Basset et al., 2019). Organizations can address disruptions either reactively or proactively. Reactive responses characterize agile supply chains, while proactive measures define robust supply chains (Cohen & Kouvelis, 2020). A resilient supply chain balances both strategies, being adaptable and robust (El Baz & Ruel, 2020). Resilience and robustness are thus critical dimensions of agility.

Flexibility, a key feature of leagile supply chains, supports agility. Flexibility encompasses product modification, diversity (mix), volume adjustment, and delivery timing (Fadaki et al., 2020; Chan et al., 2017; Lyons et al., 2020). Product flexibility refers to modifying or introducing products (Manning & Soon, 2016), while mix flexibility involves altering the diversity of outputs over time. Volume flexibility adjusts output levels, and delivery flexibility modifies delivery schedules.

Although lean and agile paradigms share goals of creating value and improving performance, agile prioritizes flexibility to adapt to dynamic environments, whereas lean emphasizes cost reduction. Flexibility, defined as adaptability with minimal negative impact on cost, time, or performance, is essential for managing variability and uncertainty (Sreedevi & Saranga, 2017; Lyons et al., 2020). Flexibility is indispensable for responding to unplanned changes, aligning with contingency theory's view that management must adapt to situational constraints (Baker, 2017). Firms that effectively manage flexibility in dynamic environments are better positioned for success.

2.5. Supply chain efficiency

Vaishnavi and Suresh (2020) emphasize that the primary motive for adopting agility and lean practices is to increase efficiency by eliminating waste and optimizing processes. These principles benefit both humanitarian and commercial organizations. Shafiq and Soratana (2020) describe leanness as optimizing waste through efficient processes, typically aiming to minimize costs by "doing more with less." Lean strategies involve techniques such as process optimization and value stream analysis, as supported by Fatime and Odock (2019), who define leagility as creating a value stream that eliminates waste, including time, and ensures level scheduling. Humanitarian supply chains, operating in volatile and unpredictable environments, require flexibility and waste minimization to ensure efficient operations. Lean principles focus on reducing resource waste by identifying and eliminating non-value-adding activities (Bag et al., 2020). For example, lean procurement streamlines processes plagued by inefficiencies, including excessive invoices, uncontrolled expenditures, and limited accountability.

Both commercial and humanitarian supply chains strive to improve efficiency; however, the unpredictable nature of humanitarian operations makes it challenging to eliminate waste. Continuous improvement initiatives, however, enable humanitarian organizations to manage waste better (Olaogbebikan & Oloruntoba, 2017). Lean concepts, described as managerial practices that eliminate waste across the value chain, emphasize value identification and enhancement, waste elimination, and flow generation (Muchiri, 2017; Osore et al., 2020). Value stream mapping (VSM), a critical lean tool, identifies and eliminates waste in the supply chain by analyzing information and material flows from raw materials to final consumers (Keyte & Locher, 2016). VSM promotes comprehensive solutions rather than addressing individual processes, fostering continuous improvement (Sweeney & Business, 2017).

In commercial logistics, the primary goal is cost minimization, while in humanitarian logistics, the focus is on reducing human suffering (Tull, 2020). However, it is challenging to quantify the cost of human suffering. A qualitative assessment of aid in Somalia highlighted the difficulty of achieving similar outcomes with less financial effort, noting that lower costs could compromise the lives of those in need. Yet, detailed data on humanitarian logistics costs remains scarce (Roblin, 2019; Hein et al., 2020). Logistics accounts for 60-80% of humanitarian intervention costs, underscoring the need for cost-effective aid (Besiou & Van Wassenhove, 2020). Current fragmented logistics models, where each NGO operates independently, are unsustainable. Research advocates a strategic approach to logistics, integrating early decision-making and fund optimization to enhance humanitarian outcomes (Lacourt & Radosta, 2019; Lewin et al., 2018).

2.6. Supply chain integration

Supply chain integration refers to the extent to which an organization’s activities and stakeholders are unified, including effective communication and information flow among all supply chain actors (Olaogbebikan & Oloruntoba, 2017). It describes relationships within and across organizations, enabling the integration of various processes both internally and externally. While integration enhances knowledge, it may also introduce challenges. Managers must carefully design integration forms, focus areas, and procedures to ensure success (Olaogbebikan & Oloruntoba, 2017). Enhanced supply chain integration can significantly improve organizational performance (Christopher, 2016).

Supply chain integration involves coordinating the movement of products and the flow of information among supply chain partners (Vanpoucke, Vereecke, & Muylle, 2017). It represents a strategic collaboration of intra- and inter-organizational processes (Zhang, Donk & Vaart, 2016). Effective integration ensures coordinated flows of materials and information, reducing boundaries and uncertainty while improving supply chain performance (Shukor et al., 2020). It incorporates perspectives such as customer, supplier, and internal integration (Ayoub et al., 2017), as well as relational and behavioral dimensions (Liu & Lee, 2018). Robust information systems are vital for building networks that facilitate seamless information, financial, and material flows, delivering value across supply chains.

Collaboration is central to integration, especially in humanitarian contexts, where organizations work together during crises to achieve tangible benefits, such as increased coverage (Rodríguez-Espíndola et al., 2018). The scale of modern crises often exceeds the capacity of individual organizations,

necessitating collaboration for effective humanitarian logistics and response. Effectiveness, defined as achieving intended goals, is greatly enhanced by such cooperation (Sabri et al., 2019).

Coordination is another crucial component, ensuring humanitarian responses align with principles of humanity, neutrality, and impartiality. Effective coordination involves logistics and transportation, which are crucial for reducing costs and enhancing services (Dubey & Altay, 2018). Without proper coordination, the efforts of multiple organizations during disasters are often ineffective, underscoring the need for unified responses.

Information sharing is equally essential, involving strategic and tactical data about logistics, populations, inventory, and production (Christopher, 2016). Sharing accurate information reduces uncertainty and enhances decision-making in areas such as order placement and capacity planning, thereby improving overall supply chain performance (Ributhi, 2020). Modern organizations increasingly use information systems to facilitate integration, connecting people, processes, and materials. These systems offer a shared architecture that coordinates both internal and external functions, enabling efficient supply chain operations (Saberi et al., 2019).

2.7. Organizational characteristics

Organizational characteristics encompass features derived from the management model, structure, strategy, and perceptions influenced by the membership and external affiliations of the organization. Key factors impacting the performance of humanitarian aid organizations include organizational size, structure, and age within the industry (Mutebi, Ntayi, Muhwezi & Munene, 2020). Olaogbebikan and Oloruntoba (2017) found a positive relationship between firm size and performance, using metrics such as sales and total assets, as well as profitability measures like profit margin and return on assets. Similarly, Isik, Unal, and Unal (2017), in their analysis of Turkish manufacturing firms, confirmed a strong correlation between firm size and performance. However, Wayongah (2019) reported a negative relationship between size and profit margin in the financial services sector. Thus, firm size may influence the performance outcomes of humanitarian organizations adopting leagile supply chain strategies.

Organizational structure also significantly affects performance. It encompasses supervision, departmental composition, and workflow within an institution. Performance management, which aims to improve individual or group productivity through goal setting and evaluation, is influenced by a firm's structure. Effective performance management depends on aligning organizational performance goals with appropriate structural arrangements. Organizational structure, typically visualized as a top-down hierarchy, assigns specific roles and reporting relationships. This layout determines which positions oversee and assess others, directly impacting relationships between managers and subordinates and ensuring accountability in humanitarian organizations.

2.8. Performance of humanitarian aid organizations

Donors increasingly demand accountability, transparency, and value for money regarding the resources they provide to humanitarian aid agencies (Bhatta, 2019). They prioritize understanding how effectively an organization accomplishes its goals using the resources allocated. According to Dubey and Gunasekaran (2016), humanitarian aid must be relevant, adhere to human standards, be managed appropriately, and aim for sustainable solutions with adequate resources. This underscores the importance of mechanisms for measuring the performance of humanitarian organizations, though differing stakeholder priorities make defining such performance challenging (Khan, Yong & Han, 2019).

In humanitarian supply chains, donors act as upstream clients, while beneficiaries are downstream clients. Due to the financial reliance of humanitarian organizations on donors, the latter often wield significant decision-making power. However, operational success requires striking a balance between donor demands and beneficiary needs. Research into humanitarian performance management is limited, with a scarcity of tools for measuring effectiveness and efficiency according to standards like ISO. This lack of integration between agile and lean strategies reflects an operational gap that hinders sustainable performance improvements globally (Shafiq et al., 2021).

A non-profit organization's performance relies heavily on its ability to secure funds to achieve its mission (Şanal & Nsubuga, 2018). Osei (2017) warns against over-prioritizing fundraising at the

expense of outcomes like effectiveness, quality, and client satisfaction. Adjustments should emphasize assessing the outcomes, efficiency, and efficacy of organizational activities relative to the resources used. Metrics proposed by Kwena et al. (2020) include resource, output, and flexibility measures to evaluate efficiency, effectiveness, and adaptability to changing environments.

Performance measurement is essential for improving humanitarian logistics, yet it remains underdeveloped. Unique challenges in the disaster relief environment, as well as ambiguity in the non-profit sector, complicate its implementation (Frennesson et al., 2020). Developing appropriate performance metrics can help measure the impacts of disasters, enhance preparedness, and efficiently manage donor funds to maximize aid for beneficiaries (Negi & Negi, 2020). However, most frameworks are adapted from commercial models, which often fail to suit humanitarian needs. Generic models, such as the SCOR framework or Balanced Scorecard, are not universally accepted by humanitarian organizations (Anjomshoae et al., 2019). Moreover, organizations with performance metrics often use too many, straining resources for data tracking and maintenance (Patil et al., 2020).

3. Research methodology

A survey research design was employed for this study. This research design is appropriate where a large population is geographically spread, which was the case in this study. The design enabled the study to apply both qualitative and quantitative research approaches, as observed by Rahi (2017), which reinforce each other. The target population of this study consisted of 330 humanitarian aid organizations operating in Kenya, as identified by the NGO Coordination Board of Kenya (2018). This study was a census examining the entire population (Mujere, 2016), specifically supply chain managers, who have a particular set of characteristics, such as specific experience, knowledge, skills, or exposure to an event. Questionnaires were used to obtain primary data for the study. The questionnaires contained structured and semi-structured questions that captured the various variables of the study. The questionnaires were hand-delivered by research assistants to the respondents using a drop-and-pick technique. Concerning the qualitative aspects of the study (open-ended questions), the authenticity of the findings was considered primal; thus, the researcher hoped that respondents would be truthful by avoiding giving distorted accounts of events surrounding supply chain efficiency.

The study employed both descriptive statistics and inferential statistics, utilizing a quantitative and qualitative approach. The study employed inferential data analysis to enable it to make inferences that extend beyond the immediate data alone to the whole population (Trafimow, 2017). The study utilized SPSS version 28 to facilitate data analysis. Inferential data analysis was done using the Pearson correlation coefficient and regression analysis. Data were also analyzed using descriptive statistics, including measures of central tendency, measures of dispersion, and measures of symmetry, as well as inferential statistics. Linear regression analysis revealed the correlation and strength of the relationship between both independent and dependent variables. Analysis of Variance also sought to test the goodness of fit of the regression models and, finally, to test the hypothesis of the regression models. Data collected from open-ended questions was analyzed qualitatively through content analysis. The information was presented using a combination of statistical techniques and graphical techniques. The hypothesis was tested by running an Ordinary Least Square regression model for the combined sub-constructs of each independent variable against the combined measures of the dependent variable. The acceptance/rejection criteria were that if the P-value is greater than 0.05, the study fails to reject the H0; however, if the P-value is less than 0.05, the H0 is rejected.

To determine the relationship between supply chain leagility and the performance of humanitarian aid organizations in Kenya, a multiple regression model was used. The regression model is illustrated below;

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon \quad (1)$$

Where: Y=Performance of Humanitarian Aid Organizations
β_0 = Y intercept
X_1 = Supply Chain Responsiveness
X_2 = Supply Chain Resilience
X_3 = Supply Chain Efficiency

X_4 = Supply Chain Integration
έ = Error term
β_1, β_2, β_3 and β_4 represent the coefficients of each independent variable.

To determine the moderating effect of organizational characteristics on the relationship between supply chain leagility and the performance of humanitarian aid organizations in Kenya, Moderated Multiple Regression (MMR) analysis was followed. This model was used to test hypothesis 5. The moderating model tests whether the prediction of a dependent variable (Y) from an independent variable (X) varies across levels of a third variable (Z). The MMR technique consists of two steps. In the first step, the main effects of the predictors and the hypothesized moderator (Z) were estimated using regression.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_z Z + \varepsilon \quad (2)$$

Where:
β_0 = Y intercept
β_1, β_2, β_3 and β_4 represent the coefficients of each independent variable.
β_z= the estimate of the population regression coefficient for Z
Z= Organizational Characteristics.
Y=Performance of Humanitarian Aid Organizations
ε = a residual term.
The second step consisted of adding the interaction term to the equation (3) as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_z Z + \beta_{1z} X_1 Z + \beta_{2z} X_2 Z + \beta_{3z} X_3 Z + \beta_{4z} X_4 Z + \varepsilon$$

Where:
β_{1z}, β_{2z} , β_{3z} , and β_{4z} are the estimates of the population regression coefficient for the product term (X*Z)

4. Research findings and discussions

The researcher distributed 330 questionnaires, from which 290 were filled out and returned, yielding an 87.88% response rate, as indicated in Table 1. This was a perfect representation and enough to make generalizations of the study findings. The unsuccessful response rate was 12.12%.

Table 1: Response rate

Category	Frequency	Percentage
Response	290	97.64
Non-response	7	2.36
Total	**297**	**100**

4.1. Regression analysis results

Table 2 illustrates the correlation matrix between the independent variables. Correlation is essentially a tool for determining how a collection of variables relate (Gogtay & Thatte, 2017), thereby facilitating the testing for multicollinearity. That the correlation values are not close to 1 or -1 is an indication that the factors are sufficiently different measures of separate variables (Gogtay & Thatte, 2017). It also implies that the variables are not multicollinear. When there is no multicollinearity, the study can utilize all the independent variables.

Table 2: Results for Correlation of Study Variables

		Performance of HAOs	SC Responsiveness	SC Resilience	SC Efficiency	SC Integration	Organizational characteristics
Performance of HAOs	Pearson Correlation	1					
	Sig. (2-tailed)						
	N	290					
Supply Chain Responsiveness	Pearson Correlation	.765**	1				
	Sig. (2-tailed)	0.000					
	N	290	290				
Supply Chain Resilience	Pearson Correlation	.708**	.595**	1			
	Sig. (2-tailed)	0.000	0.000				
	N	290	290	290			
Supply Chain Efficiency	Pearson Correlation	0.661**	0.310	.350**	1		
	Sig. (2-tailed)	0.000	0.002	0.000			
	N	290	290	290	290		
Supply Chain Integration	Pearson Correlation	.639**	.535**	.423**	.455**	1	
	Sig. (2-tailed)	0.000	0.000	0.000	0.000		
	N	290	290	290	290	290	
Organizational Characteristics	Pearson Correlation	.475**	.275**	.331**	.516**	.308**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	
	N	290	290	290	290	290	290

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

The correlation coefficient ranges from -1.00 to +1.00. A value of -1.00 signifies a perfect negative correlation, whereas a value of +1.00 represents a perfect positive correlation. A value of 0.00 implies the absence of any relationship among the variables being tested. This finding aligns with those of Akoglu (2018). Table 2 indicates that supply chain responsiveness and supply chain resilience have a significant positive relationship, as indicated by the correlation coefficient of 0.595 and a p-value of less than 0.05. This is expected because a resilient supply chain is robust and quickly adjusts to normal after disruptions, making it responsive to the needs of vulnerable people, regardless of the circumstances. Supply chain resilience certifies an organization's ability to detect potential hazards, organize a response, and adjust schedules in the face of unexpected circumstances and varying levels of urgency, as well as alter supplier capabilities when unforeseen events occur. For quick recovery to be possible, humanitarian organizations should have the ability to identify the disrupted supplies, the products comprising those components, the existing stock across the supply chain, and options for an alternative supply plan. This is in the effort to be agile enough so as not to be incapacitated by disruptions by understanding quickly and acting faster.

The results show a positive and significant relationship between supply chain responsiveness and supply chain efficiency, as proven by the p-value and the correlation coefficient ($r = 0.310$, $p < 0.05$). Typically, waste within the supply chain hinders the chain's ability to react and respond to societal needs. Inefficiency in activities due to failed coordination results in poor responsiveness and time wastage in acquiring the items needed for a particular disaster.

A strong and significant relationship exists between supply chain responsiveness and supply chain integration ($r = 0.535$, $p < 0.05$). This is because supply chain responsiveness refers to the ability of an organization and its partners to react to opportunities and exceptions in a consistent, unified, and collaborative manner that satisfies vulnerable populations and reduces supply chain costs. Humanitarian aid is not a one-person show, and all parties involved are potential influencers of the activities. This diversity of inclusivity leads to the complexity of relief operations, thus necessitating the

integration of supply chains and the proper coordination of humanitarian activities. The appropriateness of integration in disaster response management is unchallenged, with the absence of coordination resulting in a variety of potential letdowns that undoubtedly lead to crisis intensification and increased casualty counts.

The results indicate a significant positive weak correlation between supply chain resilience and supply chain efficiency ($r = 0.350$, $p < 0.05$). To be resilient, humanitarian supply chains aim to develop increased efficiency by eliminating waste in the unpredictable nature of the humanitarian supply chain. However, it is challenging to eliminate waste throughout the supply chain. There is a significant, moderate positive correlation between supply chain resilience and supply chain integration ($r = 0.423$, $p < 0.05$). This is because for supply chains to revert to their normal state or transition to a new, more desirable state, a significant amount of information sharing and cohesiveness is required among partners. Resilience in the humanitarian sector is the ability of the supply chain to survive and thrive in crises and turbulence, and this requires combined efforts from all parties involved.

A very significant positive relationship exists between supply chain efficiency and supply chain integration ($r = 0.455$, $p < 0.05$). There is evidence that coordination presence enhances the overall efficiency of disaster operations, while its absence leads to the wastage of resources and a crucial delay in response time. The failure of humanitarian actors to work together can lead to gaps in coverage duplications and inefficiencies in any given emergency response. From the findings in Table 2, all the independent variables are positively related to organizational characteristics as attested by the respective correlation coefficients: supply chain responsiveness ($r=0.275$, $p<0.05$), supply chain resilience ($r=0.331$, $p<0.05$), supply chain efficiency ($r=0.516$, $p<0.05$) and supply chain integration ($r=0.308$, $p<0.05$). All the relationships are rendered significant since their p-values are less than 0.05.

4.2. Multiple regression analysis results

A multiple linear regression analysis was done to examine the relationship between independent and dependent variables before including the moderating variable (organizational characteristics). An ordinary least square regression model was then established without the moderating variable. The model was of the form:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon \quad (3)$$

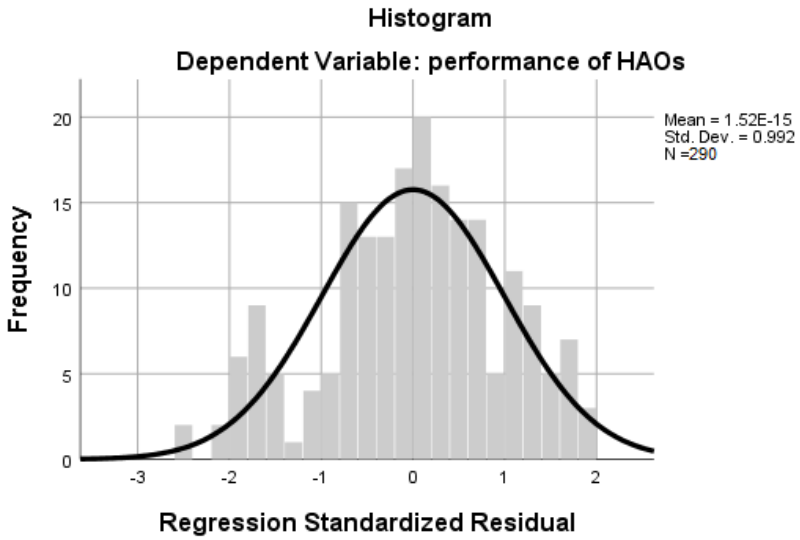
Where: Y=Performance of Humanitarian Aid Organizations
β_0 = Y-intercept
X_1 = Supply Chain Responsiveness
X_2 =Supply Chain Resilience
X_3 = Supply Chain Efficiency
X_4 =Supply Chain Integration.
ε = Error term
β_1, β_2, β_3 and β_4 represent the coefficient of each independent variable.

The adjusted R^2 is the coefficient of determination. This value explained how the performance of huma

nitarian aid organizations varied with supply chain responsiveness, supply chain resilience, supply chain efficiency, and supply chain integration. The study findings in Table 3 indicate that supply chain responsiveness, supply chain resilience, supply chain efficiency, and supply chain integration are jointly positively associated with the performance of humanitarian aid organizations, as indicated by the Pearson Correlation Coefficient R, with a value of 0.848.

The histogram in Figure 2 indicates that the data was normally distributed. The residual describes the error in the fit of the model to the i^{th} observation, yi, and is used to provide information about the adequacy of the fitted model. According to Wogi, Wakweya, and Tesfay (2018), analyzing the residuals is often helpful in verifying the assumption that errors are normally distributed with constant variance and in determining whether additional terms in the model would be beneficial.

Figure 2: Histogram of performance of humanitarian aid organizations



Furthermore, the model summary table shows that 71.9% of the change in performance of humanitarian aid organizations can be explained by four predictors, namely supply chain responsiveness, supply chain resilience, supply chain efficiency, and supply chain integration. This implies that the remaining 28.1% of the variation in the performance of humanitarian aid organizations could be attributed to other factors not examined in this study.

Table 3: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.848a	.719	.692	.49346

a. Predictors: (Constant), Supply Chain Responsiveness, Supply Chain Resilience, Supply Chain Efficiency and Supply Chain Integration

Analysis of variance (ANOVA) was performed to assess the model's fitness. The ANOVA table indicates that the F-ratio ($F = 182.310$, $p < 0.05$) was statistically significant. This means that the model used was appropriate, and the relationship of the variables shown could not have occurred by chance.

Table 4: ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	129.074	4	32.269	182.310	.000b
	Residual	50.446	285	.177		
	Total	179.520	289			

a. Dependent Variable: Performance of Humanitarian Aid Organizations

b. Predictors: (Constant), Supply Chain Responsiveness, Supply Chain Resilience, Supply Chain Efficiency and Supply Chain Integration

The estimated coefficients (βs) show the contribution of each independent variable to the change in the dependent variable. The coefficient table results show that supply chain responsiveness ($\beta = .532$, $p < 0.05$), supply chain resilience ($\beta = .316$, $p < 0.05$), supply chain efficiency ($\beta = .415$, $p < 0.05$), and supply chain integration ($\beta = .458$, $p < 0.05$) positively and significantly affected the performance of humanitarian aid organizations. This implies that an increase in any of the factors results in an improvement in the performance of humanitarian aid organizations in Kenya.

Table 5: Coefficients of Determination

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.409	0.641		5.318	0.000
	Supply chain responsiveness	0.532	0.115	0.668	4.626	0.000
	Supply chain resilience	0.316	0.081	0.442	3.901	0.000
	Supply chain efficiency	0.415	0.074	0.512	5.608	0.000
	Supply chain integration	0.458	0.098	0.583	4.673	0.000

a. Dependent Variable: Performance of Humanitarian Aid Organizations

The model before moderation was:

Performance of Humanitarian Aid Organizations = 3.409 + 0.532 Supply Chain Responsiveness + 0.316 Supply Chain Resilience + 0.415 Supply Chain Efficiency + 0.458 Supply Chain Integration.

4.3. Moderating effect of organizational characteristics

The study hypothesis was;

H_{05}: Organizational characteristics do not have a moderating effect on the relationship between supply chain responsiveness, supply chain resilience, supply chain efficiency, supply chain integration, and the performance of humanitarian aid organizations in Kenya.

Moderated Multiple Regression (MMR) analysis was employed to investigate the moderating effect of organizational characteristics on the relationship between supply chain leagility and the performance of humanitarian aid organizations in Kenya. The moderating model tests whether the prediction of a dependent variable Y from an independent variable X differs across levels of a third variable Z. The MMR technique consisted of two steps. In the first step, the main effects of the predictor (supply chain leagility) and the hypothesized moderator (organizational characteristics) were estimated using regression. To assess the moderating effect of organizational characteristics, the following models were used:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_Z Z + \varepsilon \quad (4)$$

The second step consisted of adding the interaction term to the equation (3) as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_Z Z + \beta_{1z} X_1 * Z + \beta_{2z} X_2 * Z + \beta_{3z} X_3 * Z + \beta_{4z} X_4 * Z + \varepsilon$$

Where:

β_0 = Y-intercept

β_1, β_2, β_3 and β_4 represent the coefficients of each independent variable.

β_z = the estimate of the population regression coefficient for Z

$\beta_{1Z}, \beta_{2Z}, \beta_{3Z}$ and β_{4Z} = are the estimates of the population regression coefficient for the product term (X*Z)

Z= Organizational Characteristics.

Y=Performance of Humanitarian Aid Organizations

ε = a residual term.

The hypothesis to test for this specific objective was:

H_0: Organizational characteristics do not have a moderating effect on the relationship between supply chain responsiveness, supply chain resilience, supply chain efficiency, supply chain integration, and the performance of humanitarian aid organizations in Kenya.

The moderated multiple linear regression involved three models. Model 1: estimating the primary influence of the supply chain leagility on the performance of HAOs; Model 2: estimating the primary influence of the supply chain leagility and the moderator; and Model 3: estimating the effect of the interaction between the moderator and the supply chain leagility. The model summary result in Table 6 indicates that the unadjusted coefficient of determination for model 1 is 0.719. This implies that the supply chain leagility considered in this study accounts for only 71.9 percent of the total variation in the

performance of HAOs. The remaining 28.1 percent change in the performance of HAOs can be attributed to other factors not considered in this study. For model 2, the R^2 =0.783, an implication that supply chain leagility and organizational characteristics account for about 78.3 percent of the total change in the performance of HAOs, and thus the remaining 21.7 percent of the variation in the performance of HAOs can be accounted for by other factors, not of interest in this study. For model 3, the R^2 =0.827, and this implies that supply chain leagility, organizational characteristics as well as the interaction between supply chain leagility and the organizational characteristics, accounts for 82.7 percent of the total variation in the performance of HAOs, the remaining 17.3 percent change in the performance of HAOs can be attributed to other factors. The R^2 increased by 6.4 percent when organizational characteristics were considered in addition to supply chain leagility, and by 10.8 percent when the interaction between the moderator and supply chain leagility was considered.

Table 6: Summary models used to test for the moderating effect

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R square change
1	.848a	.719	.692	.49346	.719
2	.885b	.783	.763	.71839	.064
3	.909c	.827	.818	.65124	.108

a. Predictors: (Constant), Supply Chain Responsiveness, Supply Chain Resilience, Supply Chain Efficiency and Supply Chain Integration

b. Predictors: (Constant), Supply Chain Responsiveness, Supply Chain Resilience, Supply Chain Efficiency, Supply Chain Integration and Organizational Characteristics

c. Predictors: (Constant), Supply Chain Responsiveness, Supply Chain Resilience, Supply Chain Efficiency, Supply Chain Integration, Organizational Characteristics, interaction between supply chain leagility and organizational characteristics

d. Dependent Variable: Performance of Humanitarian Aid Organizations

Table 7 shows the ANOVA results for the models considered in testing for the moderating effect of organizational characteristics. The results, Model 1 (F-statistic = 182.310, $p < 0.05$), Model 2 (F-statistic = 205.204, $p < 0.05$), and Model 3 (F-statistic = 148.603, $p < 0.05$), indicate that all three models remained significant despite the use of different predictors.

Table 7: ANOVA for the models used to test for the moderating effect

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	129.074	4	32.269	182.310	.000b
	Residual	50.446	285	.177		
	Total	179.520	289			
2	Regression	140.564	5	28.113	205.204	.000c
	Residual	38.956	284	.137		
	Total	179.520	289			
3	Regression	148.463	9	16.495	148.603	.000d
	Residual	31.057	280	.111		
	Total	179.520	289			

a. Dependent Variable: Performance of Humanitarian Aid Organizations

Table 8 presents the regression coefficients, the t-statistic, and the significance of the coefficients obtained from the three models used to investigate whether organizational characteristics have a moderating effect on the relationship between supply chain leagility and the performance of HAOs. The result indicates that when supply chain leagility components considered in this study are used together in multiple linear regression, then supply chain responsiveness (β=.532, *p<0.05*), supply chain resilience (β=0.316, p<0.05), supply chain efficiency (β=0.415, p<0.05) and supply chain integration (β=.458, *p<0.05*) have a significant positive influence on the performance of HAOs.

When the moderator is included, the results of model 2 show that supply chain responsiveness (β=0.529, p<0.05), supply chain resilience (β=0.244, p<0.05), supply chain efficiency (β=0.308, p<0.05),

supply chain integration (β=0.450, p<0.05) and the moderator organizational characteristics (β=0.564, p<0.05) have a significant positive influence on the performance of HAOs.

In model 3, the interaction effect between the supply chain leagility and the moderator (organizational characteristics) was investigated. The result indicated that:

(i) There was a significant positive influence on the performance of HAOs from the interaction between organizational characteristics and supply chain responsiveness (β= 1.101, t = 3.149, p<0.05),

(ii) There was a positive and significant influence on the performance of HAOs from the interaction between organizational characteristics and supply chain resilience (β = 1.144, t = 2.816, p < 0.05).

(iii) There was a significant positive influence on the performance of HAOs from the interaction between organizational characteristics and supply chain efficiency (β= 2.209, t = 5.059, p<0.05) and

(iv) There was a positive and significant influence on the performance of HAOs from the interaction between organizational characteristics and supply chain integration (β = 1.777, t = 3.117, p < 0.05).

Table 8: Coefficients for the models used to test for moderating effect

	Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.409	0.641		5.318	0.000
	Supply Chain Responsiveness	0.532	0.115	0.668	4.626	0.000
	Supply Chain Resilience	0.316	0.081	0.442	3.901	0.000
	Supply Chain Efficiency	0.415	0.074	0.512	5.608	0.000
	Supply Chain Integration	0.458	0.098	0.583	4.673	0.000
2	(Constant)	2.493	0.661		3.772	0.000
	Supply Chain Responsiveness	0.529	0.114	0.515	4.640	0.000
	Supply Chain Resilience	0.244	0.038	4.11	6.421	0.000
	Supply Chain Efficiency	0.308	0.113	0.487	2.726	0.007
	Supply Chain Integration	0.450	0.125	0.479	3.600	0.000
	Organizational Characteristics	0.564	0.135	0.273	4.178	0.000
3	(Constant)	31.131	7.278		4.277	0.000
	Supply Chain Responsiveness	4.674	1.498	2.427	3.120	0.002
	Supply Chain Resilience	5.306	1.798	2.388	2.951	0.003
	Supply Chain Efficiency	9.168	1.864	5.563	4.918	0.000
	Supply Chain Integration	7.598	2.536	4.003	2.996	0.003
	Organizational Characteristics	8.202	1.723	3.97	4.760	0.000
	Supply Chain Responsiveness * Organization Characteristics	1.101	0.35	3.779	3.146	0.002
	Supply Chain Resilience * Organization Characteristics	1.144	0.406	3.668	2.818	0.005
	Supply Chain Efficiency * Organization Characteristics	2.209	0.437	8.896	5.055	0.000
	Supply Chain Integration * Organization Characteristics	1.777	0.57	6.272	3.118	0.002

a. Dependent Variable: Performance of Humanitarian Aid Organizations

Thus, the overall regression model after moderation becomes:

Model 1: $Y = 3.409 + 0.532X_1 + 0.316X_2 + 0.415X_3 + 0.458X_4$

Model 2: $Y = 2.493 + 0.529X_1 + 0.244X_2 + 0.308X_3 + 0.450X_4 + 0.564Z$

Model 3:

$$Y = 31.131 + 4.674X_1 + 5.306X_2 + 9.168X_3 + 7.598X_4 + 8.202Z + 1.101X_1Z + 1.144X_2Z + 2.209X_3Z + 1.777X_4Z$$

The study hypothesized that organizational characteristics does not have a moderating effect on the relationship between supply chain leagility and the performance of humanitarian aid organizations in Kenya. The interaction effect between the supply chain leagility and organizational characteristics measures the moderation effect. The rule of thumb is that if there is a significant influence on the dependent variable from the interaction between the moderator and independent variable, moderation is supported; otherwise, moderation is not supported. From the results in Table 6 to Table 8, the null hypothesis is rejected, and the study concludes that organizational characteristics have a moderating effect on the relationship between supply chain responsiveness, supply chain resilience, supply chain efficiency, supply chain integration, and the performance of humanitarian aid organizations in Kenya.

5. Discussion

Three indicators were used to measure organizational characteristics: organizational structure, firm size, and organizational age. Respondents were asked to indicate the number of years their humanitarian aid organizations had been in operation in the humanitarian industry. The study's findings indicated that humanitarian aid organizations had varied experiences within the industry. The respondents were also asked to indicate the number of employees working in the organizations. The number of employees was used to measure organizational size. The organizational size is associated with the resources in possession and the cost of running the firm. The organizational size decides the systems used to keep their operations running. Humanitarian aid organizations differ significantly in terms of financial, technical, and operational capacities, which are dependent on their size, structure, and experience in the industry.

The age of an organization affects the implementation of supply chain agility in humanitarian aid organizations. The efficient and adequate supply of information in older firms can be attributed to their firm age. The younger a firm is, the fewer relationships it has established. Older firms are better experienced in selecting and applying information. According to a study by Kücher, Mayr, Mitter, Duller, and Feldbauer-Durstmüller (2020), experience gained from existing longer in the field of humanitarian relief places older firms at an operational advantage. Older firms are also better positioned to establish reliable networks of business associates and have the trust of financial institutions. They have also established a good reputation in their line of business, which is a key driver of operational success.

Conversely, among the actors in complex emergencies, large and established humanitarian aid organizations have the fewest barriers and strengths to entry into a disaster zone. Large and experienced organizations have an advantage over their smaller and younger counterparts in implementing supply chain agility. This confirms the findings by Chan, Teoh, Yeow, and Pan (2019) that large and experienced organizations can respond quickly to changes. This is because most large humanitarian aid organizations have established conventional procedures in place for emergency responses. They also have access to sufficient labor, materials, and monetary resources that are readily available for emergency response.

Additionally, they can easily acquire extra resources when needed. These factors enable large and experienced humanitarian aid organizations to respond rapidly to complex emergencies. Again, experienced humanitarian aid organizations have the advantage of maneuverability. This enables humanitarian aid organizations to access many complicated or remote places. Some well-endowed humanitarian aid organizations have established air or sea transport capabilities, which means they can access any location. Rogerson and Ritchie (2020) asserted that small local humanitarian aid organizations should be credited for their significant contributions to relief activities. Although they may fall behind their international counterparts in terms of human and financial resources, they compensate for this with their better domestic knowledge and familiarity with the distressed populations. Matar and Eneizan (2018) supported the findings of this study and affirmed that age and size have a positive relationship with an organization's performance; therefore, they should be accorded due attention.

Organizational structure entails grouping people and responsibilities into different divisions to enhance the synchronization of communication, decisions, and actions within an organization (Burton & Obel, 2018). The chain of command, reporting structures, span of control, power, authority, and responsibility are clearly specified and assigned to individuals according to their status within an organization. Subsequently, the structure of the organization governs the rate of decision-making and

the flow of information in and outside an organization. Making decisions becomes slower when many people are expected to contribute, thereby leading to slackened humanitarian services. The organizational structure adopted by humanitarian aid organizations influences the implementation of supply chain leagility in the context of emergence and relief assistance. Centralization, formalization, red tape, and complexity structures determine how humanitarian aid organizations respond to disasters. Centralization focuses on the location of decision-making authority in the organization. Omweri (2018) notes that if a bureaucrat has limited discretion in decision-making, they would need approval from a higher-ranking official; otherwise, the decision can be made without consent. Formalization is the extent to which an organization has documented rules and regulations in paper form. Formalization ensures orderliness and a record of employee conduct. Red tape is burdensome administrative rules and procedures that have undesirable impacts on organizational performance. Complexity refers to the number of sub-units, levels, and specializations within an organization. Shareef, Dwivedi, Kumar, Hughes, and Raman (2020) concluded that the absence or weakness of an organizational structure has adverse effects on an organization's performance, regardless of the supply chain design adopted. Rigidity and bureaucracy in organizational structure result in a bewildering morass of contradictions: confusion within roles, unnecessary ambiguity, a lack of coordination among humanitarian functions, failure to share ideas, and slow decision-making. The organizational structure in disaster management should be simpler and more centralized. Disaster response should be prompt to save lives and property. Valero (2015) asserted that organizational structure is a crucial factor in swift, on-time disaster response. This implies that weakness in organizational structure inhibits a practical, well-organized, and well-timed emergency response. This confirms the assertion by Takeda, Jones, and Helms (2017) that a rigid, administrative authority and bureaucratic control method in disaster containment typically results in an ineffective emergency response. Concisely, organizational age, firm size, and organizational structure affect the relationship between supply chain leagility and performance of humanitarian aid organizations in Kenya.

6. Conclusion

The study concludes that supply chain responsiveness, supply chain resilience, supply chain efficiency, and supply chain integration are jointly positively associated with the performance of humanitarian aid organizations. Furthermore, the four predictors explain 71.9% of the variation in the performance of humanitarian aid organizations, implying that the remaining 28.1% of the variation in performance could be accounted for by other factors not considered in this study.

The study also concluded that supply chain responsiveness has a positive and significant influence on the performance of humanitarian aid organizations in Kenya. Responsive supply chains are designed to address the urgent needs of vulnerable populations by swiftly evaluating, addressing, and tracking material movements promptly. However, despite this design, challenges in the humanitarian supply chains create delays, revealing a lack of preparedness in responding to emergencies and disasters. Enhanced responsiveness reduces response time, saves lives, and improves resource utilization. Supply chain resilience also has a positive impact on organizational performance. Humanitarian supply chains are vulnerable to disruptions from both internal and external factors. Adopting a leagility design enhances their ability to adapt, recover, and sustain operations during crises, minimizing resource wastage while safeguarding vulnerable populations. Similarly, supply chain efficiency significantly influences performance by emphasizing waste reduction and eliminating non-value-adding activities, thereby optimizing resource utilization. Supply chain integration was found to be crucial for performance, as effective communication and information sharing among supply chain partners enable better decision-making during emergencies.

Organizational characteristics moderate the relationship between supply chain leagility and performance. A flexible organizational structure facilitates swift disaster response, while rigid structures hinder it. Additionally, the age and size of organizations contribute to their ability to establish networks, mobilize resources, and respond effectively, especially in hard-to-reach areas. In conclusion, supply chain responsiveness, resilience, efficiency, and integration, combined with suitable organizational characteristics, are crucial for enhancing the performance of humanitarian aid organizations in Kenya.

6. Recommendations

The study revealed that most humanitarian aid organizations in Kenya have only partially implemented leagility in their supply chains and recommends its full adoption. Collaborating with industry players can create efficient, responsive supply chains by leveraging expertise, assets, and networks to meet the needs of vulnerable populations more effectively.

Kenya's culture of disaster preparedness remains weak despite increased resource allocations. International, national, and local actors must collaborate to establish a culture of preparedness. Humanitarian supply chains should adopt hybrid models combining lean and agile operations to adapt to dynamic and complex environments.

Donors are encouraged to strengthen local capacities to prevent, prepare for, and manage crises. Local communities often provide immediate assistance during sudden disasters, saving lives before formal aid arrives. Supporting local industries and suppliers enhances supply chain resilience and responsiveness, especially during global disruptions. Donors should also increase funding while demanding accountability to ensure the efficient and high-quality delivery of aid.

Technology plays a critical role in building resilient supply chains. Advanced tools, including big data analytics, IoT, cloud computing, and AI, enable rapid decision-making, enhanced data accuracy, and seamless integration. Transitioning from static to adaptive supply chains, along with proactive measures like stockpiling and rerouting, minimizes disruptions. Outsourcing, spare capacity, and local suppliers help mitigate vulnerabilities. Historical data can enhance demand forecasting, while IT and data sharing facilitate supply chain integration, thereby reducing uncertainty and enabling better coordination. Technologies like blockchain and machine learning further boost integration and agility.

A multi-stakeholder approach is essential for disaster management legislation and preparedness plans. Flexible, less complex, and centralized organizational structures facilitate timely responses. Additionally, supporting smaller local organizations with funding and an enabling environment ensures better utilization of their local knowledge and networks, improving disaster response efficiency.

Funding

This research received no external funding.

Conflicts of interest

The author declares no conflict of interest.

Citation information

Nyile, E. K., Shale, N. I., & Osoro, A. (2025). Optimizing humanitarian aid in Kenya: The synergy between lean-agile supply chains and organizational characteristics. *Journal of Sustainable Development of Transport and Logistics, 10*(1), 152-177. doi:10.14254/jsdtl.2025.10-1.10.

References

Abdel-Basset, M., Gunasekaran, M., Mohamed, M., & Chilamkurti, N. (2019). A framework for risk assessment, management and evaluation: Economic tool for quantifying risks in supply chain. *Future Generation Computer Systems, 90*, 489–502. https://doi.org/10.1016/j.future.2018.08.035

Abdelilah, B., El Korchi, A., & Balambo, M. A. (2018). Flexibility and agility: Evolution and relationship. *Journal of Manufacturing Technology Management, 29*(7), 1138–1162. https://doi.org/10.1108/JMTM-03-2018-0090

Abdi, M. R., Labib, A. W., Edalat, F. D., & Abdi, A. (2018). *Integrated reconfigurable manufacturing systems and smart value chain: Sustainable infrastructure for the factory of the future*. Springer International Publishing. https://doi.org/10.1007/978-3-319-76846-5

Adobor, H., & McMullen, R. S. (2018). Supply chain resilience: A dynamic and multidimensional approach. *The International Journal of Logistics Management, 29*(4), 1451–1471. https://doi.org/10.1108/IJLM-04-2017-0093

Agarwal, S., Kant, R., & Shankar, R. (2019). Humanitarian supply chain management frameworks: A critical literature review. *Benchmarking: An International Journal, 26*(6), 1749–1780. https://doi.org/10.1108/BIJ-08-2018-0245

Akoglu, H. (2018). User's guide to correlation coefficients. *Turkish Journal of Emergency Medicine, 18*(3), 91–93. https://doi.org/10.1016/j.tjem.2018.08.001

Anjomshoae, A., Hassan, A., & Wong, K. Y. (2019). An integrated AHP-based scheme for performance measurement in humanitarian supply chains. *International Journal of Productivity and Performance Management, 68*(5), 938–957. https://doi.org/10.1108/IJPPM-04-2018-0132

Ayoub, H. F., Abdallah, A. B., & Suifan, T. S. (2017). The effect of supply chain integration on technical innovation in Jordan. *Benchmarking: An International Journal, 24*(4), 594–616. https://doi.org/10.1108/BIJ-06-2016-0088

Baker, T. (2017). *Performance management for agile organizations: Overthrowing the eight management myths that hold businesses back*. Springer. https://doi.org/10.1007/978-3-319-40153-9

Banikoi, H., Karky, B. S., Shrestha, A. J., & Aye, Z. M. (2018). A value chain approach to sustainable forest management? Timber supply chain practices for sustainability in Myanmar's forest sector. *Journal of Forest and Livelihood, 17*(1), 1–24.

Behl, A., & Dutta, P. (2019). Humanitarian supply chain management: A thematic literature review and future directions of research. *Annals of Operations Research, 283*(1–2), 1001–1044. https://doi.org/10.1007/s10479-018-2806-2

Besiou, M., & Van Wassenhove, L. N. (2020). Humanitarian operations: A world of opportunity for relevant and impactful research. *Manufacturing & Service Operations Management, 22*(1), 135–145. https://doi.org/10.1287/msom.2019.0799

Bhatta, S. (2019). *Accountability practices of donor-funded non-governmental organizations (NGOs): A case of Asha Nepal* [Unpublished master's thesis]. Tribhuvan University.

Biazzo, S., Panizzolo, R., & de Crescenzo, A. M. (2016). Lean management and product innovation: A critical review. In A. Chiarini & P. Found (Eds.), *Understanding the lean enterprise* (pp. 237–260). Springer. https://doi.org/10.1007/978-3-319-19995-5_11

Bortolotti, T., Romano, P., Martinez-Jurado, P. J., & Moyano-Fuentes, J. (2016). Towards a theory for lean implementation in supply networks. *International Journal of Production Economics, 175*, 182–196. https://doi.org/10.1016/j.ijpe.2016.02.020

Brusset, X., & Teller, C. (2017). Supply chain capabilities, risks, and resilience. *International Journal of Production Economics, 184*, 59–68. https://doi.org/10.1016/j.ijpe.2016.09.008

Burton, R. M., & Obel, B. (2018). The science of organizational design: Fit between structure and coordination. *Journal of Organization Design, 7*(1), 1–13. https://doi.org/10.1186/s41469-018-0029-2

Caldecott, J. (2017). *Aid performance and climate change*. Routledge. https://doi.org/10.4324/9781315231495

Chan, A. T., Ngai, E. W., & Moon, K. K. (2017). The effects of strategic and manufacturing flexibilities and supply chain agility on firm performance in the fashion industry. *European Journal of Operational Research, 259*(2), 486–499. https://doi.org/10.1016/j.ejor.2016.11.006

Chan, C. M., Teoh, S. Y., Yeow, A., & Pan, G. (2019). Agility in responding to disruptive digital innovation: Case study of an SME. *Information Systems Journal, 29*(2), 436–455. https://doi.org/10.1111/isj.12215

Chavez, R., Yu, W., Feng, M., & Wiengarten, F. (2016). The effect of customer-centric green supply chain management on operational performance and customer satisfaction. *Business Strategy and the Environment, 25*(3), 205–220. https://doi.org/10.1002/bse.1868

Chirchir, S. K. (2018). *Logistics management practices and organizational performance of dairy firms in Kenya* [Doctoral dissertation, University of Nairobi].

Christopher, M. (2016). *Logistics & supply chain management* (5th ed.). Pearson.

Christopher, M., Harrison, A., & van Hoek, R. (2016). Creating the agile supply chain: Issues and challenges. In *Developments in logistics and supply chain management* (pp. 61–68). Palgrave Macmillan. https://doi.org/10.1057/9781137541253_6

Cockton, G., Lárusdóttir, M., Gregory, P., & Cajander, Å. (2016). Integrating user-centered design in agile development. In *Integrating user-centered design in agile development* (pp. 1–46). Springer. https://doi.org/10.1007/978-3-319-32165-3_1

Cohen, M. A., & Kouvelis, P. (2020). Revisit of AAA excellence of global value chains: Robustness, resilience, and realignment. *Production and Operations Management*. https://doi.org/10.2139/ssrn.3701102

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage Publications.

Datta, P. (2017). Supply network resilience: A systematic literature review and future research. *The International Journal of Logistics Management, 28*(2), 138–162. https://doi.org/10.1108/IJLM-03-2016-0064

Datta, P. P. (2017). Enhancing competitive advantage by constructing supply chains to achieve superior performance. *Production Planning & Control, 28*(1), 57–74. https://doi.org/10.1080/09537287.2016.1231854

Dubey, R., & Altay, N. (2018). Drivers of coordination in humanitarian relief supply chains. In *The Palgrave handbook of humanitarian logistics and supply chain management* (pp. 297–325). Palgrave Macmillan. https://doi.org/10.1057/978-1-137-59099-2_10

Dubey, R., & Gunasekaran, A. (2016). The sustainable humanitarian supply chain design: Agility, adaptability and alignment. *International Journal of Logistics Research and Applications, 19*(1), 62–82. https://doi.org/10.1080/13675567.2015.1015511

Dubey, R., Gunasekaran, A., Childe, S. J., Roubaud, D., Wamba, S. F., Giannakis, M., & Foropon, C. (2019). Big data analytics and organizational culture as complements to swift trust and collaborative performance in the humanitarian supply chain. *International Journal of Production Economics, 210*, 120–136. https://doi.org/10.1016/j.ijpe.2019.01.023

Dufour, É., Laporte, G., Paquette, J., & Rancourt, M. È. (2018). Logistics service network design for humanitarian response in East Africa. *Omega, 74*, 1–14. https://doi.org/10.1016/j.omega.2017.01.002

El Baz, J., & Ruel, S. (2020). Can supply chain risk management practices mitigate the disruption impacts on supply chains' resilience and robustness? Evidence from an empirical survey in a COVID-19 outbreak era. *International Journal of Production Economics, 229*, 107972. https://doi.org/10.1016/j.ijpe.2020.107972

Elbert, R., Gerdes, U. T., Kaiser, G., & Sarnow, T. (2018). Governance and moderating effects of environmental uncertainty: The impact on performance in horizontal logistics cooperations. *Logistics Research, 11*(4), 1–29.

Eltantawy, R. A. (2016). The role of supply management resilience in attaining ambidexterity: A dynamic capabilities approach. *Journal of Business & Industrial Marketing, 31*(1), 123–134. https://doi.org/10.1108/JBIM-05-2014-0091

Fadaki, M., Rahman, S., & Chan, C. (2020). Leagile supply chain: Design drivers and business performance implications. *International Journal of Production Research, 58*(18), 5601–5623. https://doi.org/10.1080/00207543.2019.1693660

Fatime, S. S., & Odock, S. (2019). *Leagile manufacturing practices and supply chain performance of food and beverage manufacturing companies in Kenya* [Unpublished MBA project]. University of Nairobi.

Frennesson, L., Kembro, J., de Vries, H., Van Wassenhove, L., & Jahre, M. (2020). Localisation of logistics preparedness in international humanitarian organisations. *Journal of Humanitarian Logistics and Supply Chain Management, 10*(3), 363–385. https://doi.org/10.1108/JHLSCM-06-2020-0048

Galankashi, M. R., & Helmi, S. A. (2016). Assessment of hybrid Lean-Agile (Leagile) supply chain strategies. *Journal of Manufacturing Technology Management, 27*(4), 470–482. https://doi.org/10.1108/JMTM-07-2015-0053

Ganguly, K. K., Padhy, R. K., & Rai, S. S. (2017). Managing the humanitarian supply chain: A fuzzy logic approach. *International Journal of Disaster Resilience in the Built Environment, 8*(3), 310–327. https://doi.org/10.1108/IJDRBE-07-2015-0038

Gichuki, C. M. (2017). *Effect of agile supply chain strategy on competitive advantage of firms in the fast moving consumer goods industry: A case of Unilever Kenya* [Master's thesis]. United States International University-Africa.

Gitonga, M. M. (2021). *Supply chain resilience and operational performance of manufacturing small and medium enterprises operating within the industrial area Nairobi County* [Unpublished doctoral dissertation]. University of Nairobi.

Gogtay, N. J., & Thatte, U. M. (2017). Principles of correlation analysis. *Journal of the Association of Physicians of India, 65*(3), 78–81.

Grange, R., Heaslip, G., & McMullan, C. (2019). Coordination to choreography: The evolution of humanitarian supply chains. *Journal of Humanitarian Logistics and Supply Chain Management, 9*(2), 192–218. https://doi.org/10.1108/JHLSCM-12-2018-0077

Gunasekaran, A., Papadopoulos, T., Dubey, R., Wamba, S. F., Childe, S. J., Hazen, B., & Akter, S. (2017). Big data and predictive analytics for supply chain and organizational performance. *Journal of Business Research, 70*, 308–317. https://doi.org/10.1016/j.jbusres.2016.08.004

Hein, C., Behrens, F., & Lasch, R. (2020). Insights on the costs of humanitarian logistics: A case study analysis. *Logistics Research, 13*(1), 3. https://doi.org/10.23773/2020_1

Hugos, M. H. (2018). *Essentials of supply chain management* (4th ed.). Wiley. https://doi.org/10.1002/9781119464495

Isik, O., Unal, E. A., & Unal, Y. (2017). The effect of firm size on profitability: Evidence from Turkish manufacturing sector. *Journal of Business Economics and Finance, 6*(4), 301–308. https://doi.org/10.17261/Pressacademia.2017.762

Jahre, M. (2017). Humanitarian supply chain strategies: A review of how actors mitigate supply chain risks. *Journal of Humanitarian Logistics and Supply Chain Management, 7*(1), 82–101. https://doi.org/10.1108/JHLSCM-12-2016-0043

Kamalahmadi, M., & Parast, M. M. (2016). A review of the literature on the principles of enterprise and supply chain resilience: Major findings and directions for future research. *International Journal of Production Economics, 171*, 116–133. https://doi.org/10.1016/j.ijpe.2015.10.023

Kembro, J., Näslund, D., & Olhager, J. (2017). Information sharing across multiple supply chain tiers: A Delphi study on antecedents. *International Journal of Production Economics, 193*, 77–86. https://doi.org/10.1016/j.ijpe.2017.06.032

Keyte, B., & Locher, D. A. (2016). *The complete lean enterprise: Value stream mapping for administrative and office processes* (2nd ed.). Productivity Press. https://doi.org/10.1201/b19608

Khan, H., & Wisner, J. D. (2019). Supply chain integration, learning, and agility: Effects on performance. *Journal of Operations and Supply Chain Management, 12*(1), 14–28. https://doi.org/10.31387/oscm0360218

Khan, M., Yong, L. H., & Han, B. J. (2019). Emerging techniques for enhancing the performance of humanitarian logistics. *International Journal of Supply Chain Management, 8*(2), 450–461.

Khanuja, A., & Jain, R. K. (2019). Supply chain integration: A review of enablers, dimensions and performance. *Benchmarking: An International Journal, 26*(4), 1128–1157. https://doi.org/10.1108/BIJ-07-2018-0217

Koori, C., & Chirchir, M. (2017). *Leagile supply chain practices and supply chain performance of non-governmental health organizations in Nairobi, Kenya* [Unpublished MBA project]. University of Nairobi.

Kücher, A., Mayr, S., Mitter, C., Duller, C., & Feldbauer-Durstmüller, B. (2020). Firm age dynamics and causes of corporate bankruptcy: Age dependent explanations for business failure. *Review of Managerial Science, 14*(3), 633–661. https://doi.org/10.1007/s11846-018-0303-2

Kuria, S. W., & Chirchir, M. (2014). *Supply chain leagility and performance of humanitarian organizations in Kenya* [Unpublished MBA project]. University of Nairobi.

Kwena, R., Mukulu, E., Nzulwa, J., & Odhiambo, R. (2020). Influence of constrained programming on humanitarian project outcomes in United Nations agencies in Kenya. *Journal of Business and Change Management, 6*(1), 1–15. https://doi.org/10.61426/sjbcm.v6i1.1068

Larson, P. D., & Foropon, C. (2018). Process improvement in humanitarian operations: An organisational theory perspective. *International Journal of Production Research, 56*(21), 6828–6841. https://doi.org/10.1080/00207543.2018.1424374

Lewin, R., Besiou, M., Lamarche, J. B., Cahill, S., & Guerrero-Garcia, S. (2018). Delivering in a moving world… looking to our supply chains to meet the increasing scale, cost and complexity of humanitarian needs. *Journal of Humanitarian Logistics and Supply Chain Management, 8*(3), 307–332. https://doi.org/10.1108/JHLSCM-10-2017-0048

Liu, C. L., & Lee, M. Y. (2018). Integration, supply chain resilience, and service performance in third-party logistics providers. *The International Journal of Logistics Management, 29*(1), 5–21. https://doi.org/10.1108/IJLM-11-2016-0283

Lyons, A. C., Um, J., & Sharifi, H. (2020). Product variety, customization and business process performance: A mixed-methods approach to understanding their relationships. *International Journal of Production Economics, 221*, 107469. https://doi.org/10.1016/j.ijpe.2019.08.004

Maghsoudi, A. (2015). *Inter-organizational factors, coordination mechanism initiatives, and performance: Study of humanitarian supply chains* [Doctoral dissertation, Universiti Sains Malaysia].

Maghsoudi, A., & Pazirandeh, A. (2016). Visibility, resource sharing and performance in supply chain relationships: Insights from humanitarian practitioners. *Supply Chain Management: An International Journal, 21*(1), 125–140. https://doi.org/10.1108/SCM-03-2015-0102

Maghsoudi, A., Zailani, S., Ramayah, T., & Pazirandeh, A. (2018). Coordination of efforts in disaster relief supply chains: The moderating role of resource scarcity and redundancy. *International Journal of Logistics Research and Applications, 21*(4), 407–430. https://doi.org/10.1080/13675567.2018.1437894

Mangan, J., & Lalwani, C. C. (2016). *Global logistics and supply chain management* (3rd ed.). Wiley.

Manning, L., & Soon, J. M. (2016). Building strategic resilience in the food supply chain. *British Food Journal, 118*(6), 1477–1493. https://doi.org/10.1108/BFJ-10-2015-0350

Matar, A., & Eneizan, B. M. (2018). Determinants of financial performance in the industrial firms: Evidence from Jordan. *Asian Journal of Agricultural Extension, Economics & Sociology, 25*(2), 1–10. https://doi.org/10.9734/AJAEES/2018/37476

Meesters, K., & Wang, Y. (2021). Information as humanitarian aid: Delivering digital services to empower disaster-affected communities. In *Digital services in crisis, disaster, and emergency situations* (pp. 328–351). IGI Global. https://doi.org/10.4018/978-1-7998-6705-0.ch015

Mohammed, M. M. (2018). *Perceived factors influencing humanitarian emergency projects response in Somalia: A case of Muslim Aid Somalia* [Unpublished master's thesis]. University of Nairobi.

Mohammed, N. D. (2018). *Examining the management and stewardship of donor funds, relative to outcomes in basic education in Kenya* [Doctoral dissertation, St. Thomas University].

Mokua, C., & Kimutai, G. (2019). Monitoring and evaluation systems and performance of public private partnership projects in Nairobi City County, Kenya. *International Journal of Current Aspects, 3*(VI), 124–148. https://doi.org/10.35942/ijcab.v3iVI.82

Mostafa, S., & Dumrak, J. (2017). A waste elimination process: An approach for lean and sustainable manufacturing systems. In *Green supply chain management for sustainable business practice* (pp. 111–152). IGI Global. https://doi.org/10.4018/978-1-5225-0635-5.ch005

Muchiri, P. M. (2017). *Lean supply chain management practices and organizational performance in parastatals in the Ministry of Energy and Petroleum in Kenya* [Unpublished MBA thesis]. University of Nairobi.

Mundia, C., Nyaoga, R., Ngacho, C., & Auka, D. (2021). Mediating effect of le-agile supply chain strategies on the effect of supply chain management practices on operational performance of large manufacturing firms in Kenya. *IOSR Journal of Business and Management, 23*(7), 1–8.

Mushanyuri, B. E., & Ngcamu, B. S. (2020). The effectiveness of humanitarian supply chain management in Zimbabwe. *Journal of Transport and Supply Chain Management, 14*, 1–11. https://doi.org/10.4102/jtscm.v14i0.505

Mutebi, H., Ntayi, J. M., Muhwezi, M., & Munene, J. C. K. (2020). Self-organization, adaptability, organizational networks and inter-organizational coordination: Empirical evidence from humanitarian organizations in Uganda. *Journal of Humanitarian Logistics and Supply Chain Management, 10*(3), 415–442. https://doi.org/10.1108/JHLSCM-10-2019-0074

Mwangi, E. K., & Kamau, L. (2019). Lean manufacturing implementation in Kenya. In *Proceedings of sustainable research and innovation conference* (pp. 225–235). Jomo Kenyatta University of Agriculture and Technology.

Naburuk, L. C. (2018). *Supplier collaboration and supply chain resilience among relief organizations in Kenya* [Unpublished doctoral dissertation]. University of Nairobi.

Nayak, R., & Choudhary, S. (2020). Operational excellence in humanitarian logistics and supply chain management through leagile framework: A case study from a non-mature economy. *Production Planning & Control, 32*(7), 585–600. https://doi.org/10.1080/09537287.2020.1834135

Negi, S., & Negi, G. (2020). Framework to manage humanitarian logistics in disaster relief supply chain management in India. *International Journal of Emergency Services, 9*(3), 301–318. https://doi.org/10.1108/IJES-02-2020-0005

Njoka, J. T., Yanda, P., Maganga, F., Liwenga, E., Kateka, A., Henku, A., & Schubert, C. (2016). *Kenya: Country situation assessment* (PRISE Working Paper No. 12). Overseas Development Institute. http://prise.odi.org/wp-content/uploads/2016/01/Low-Res_Kenya-CSA.pdf

Olaogbebikan, J. E., & Oloruntoba, R. (2017). Similarities between disaster supply chains and commercial supply chains: A SCM process view. *Annals of Operations Research, 283*(1–2), 1–26. https://doi.org/10.1007/s10479-017-2690-1

Omweri, S. F. (2018). *Influence of bureaucratic culture in delivery of firefighting services in Nyamira County, Kenya* [Unpublished master's thesis]. Kisii University.

Osei, E. (2017). *Managing humanitarian relief organizations with limited resources in Ghana* [Unpublished doctoral dissertation]. University of Ghana.

Osore, E. A. E., Ogola, J. M., & Ogot, M. M. (2020). Prospects of diffusion as a Six-Sigma automation in enhancing continuous improvement of cane juice extraction in Kenya. *Cogent Engineering, 7*(1), 1733737. https://doi.org/10.1080/23311916.2020.1733737

Pati, N., Sundram, V. P. K., Chandran, V. G. R., & Bhatti, M. A. (2016). Supply chain practices and performance: The indirect effects of supply chain integration. *Benchmarking: An International Journal, 23*(6), 1445–1471. https://doi.org/10.1108/BIJ-09-2015-0092

Patil, A., Shardeo, V., & Madaan, J. (2020). Modelling performance measurement barriers of humanitarian supply chain. *International Journal of Productivity and Performance Management, 70*(1), 218–239. https://doi.org/10.1108/IJPPM-01-2020-0031

Paul, B. K. (2019). Response to and emergency relief efforts for the selected disasters. In *Disaster relief aid* (pp. 141–194). Palgrave Macmillan. https://doi.org/10.1007/978-3-319-77282-0_4

Ponnusamy, P. (2019). *Collaborative framework arrangement for agile/leagile procurement and supply of humanitarian food aid: A case study of Malaysia* [Doctoral dissertation, Curtin University].

Purvis, L., Spall, S., Naim, M., & Spiegler, V. (2016). Developing a resilient supply chain strategy during 'boom' and 'bust'. *Production Planning & Control, 27*(7–8), 579–590. https://doi.org/10.1080/09537287.2016.1165306

Qamar, A., & Hall, M. (2018). Can lean and agile organizations within the UK automotive supply chain be distinguished based upon contextual factors? *Supply Chain Management: An International Journal, 23*(6), 498–516. https://doi.org/10.1108/SCM-05-2017-0185

Rahi, S. (2017). Research design and methods: A systematic review of research paradigms, sampling issues and instruments development. *International Journal of Economics & Management Sciences, 6*(2), 1–5. https://doi.org/10.4172/2162-6359.1000403

Rahman, M. T., Majchrzak, T. A., & Comes, T. (2019). Deep uncertainty in humanitarian logistics operations: Decision-making challenges in responding to large-scale natural disasters. *International Journal of Emergency Management, 15*(3), 276–297. https://doi.org/10.1504/IJEM.2019.102314

Rashid, K. (2018). Flood hazard mapping for the humanitarian sector: An opinion piece on needs and views. In *Global flood hazard: Applications in modeling, mapping, and forecasting* (pp. 115–130). Wiley. https://doi.org/10.1002/9781119217886.ch7

Ributhi, J. N. (2020). *Influence of knowledge centered culture on organizational agility: The mediating role of tacit knowledge sharing members of National Hospital Insurance Fund* [Unpublished master's thesis]. Kenya Methodist University.

Roblin, S. (2019). Will blood-bearing delivery drones transform disaster relief and battlefield medicine? *The National Interest*.

Rodríguez-Espíndola, O., Albores, P., & Brewster, C. (2018). Disaster preparedness in humanitarian logistics: A collaborative approach for resource management in floods. *European Journal of Operational Research, 264*(3), 978–993. https://doi.org/10.1016/j.ejor.2017.01.021

Rogerson, A., & Ritchie, E. (2020). ODA in turmoil: Why aid definitions and targets will come under pressure in the pandemic age, and what might be done about it. *ODI Report*.

Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. (2019). Blockchain technology and its relationships to sustainable supply chain management. *International Journal of Production Research, 57*(7), 2117–2135. https://doi.org/10.1080/00207543.2018.1533261

Sabri, Y., Zarei, M. H., & Harland, C. (2019). Using collaborative research methodologies in humanitarian supply chains. *Journal of Humanitarian Logistics and Supply Chain Management, 9*(3), 371–409. https://doi.org/10.1108/JHLSCM-06-2018-0041

Şanal, M., & Nsubuga, J. (2018). A research on non-profitable organizations. *Journal of Current Researches on Business and Economics, 8*(2), 271–288.

Shafiq, M., & Soratana, K. (2020). Lean readiness assessment model-a tool for humanitarian organizations' social and economic sustainability. *Journal of Humanitarian Logistics and Supply Chain Management, 10*(3), 329–346. https://doi.org/10.1108/JHLSCM-01-2019-0002

Shafiq, M., Akhtar, A., Tahir, A. H., Akhtar, N., & Kashif, A. R. (2021). Efficiency and effectiveness of humanitarian organizations' logistics and supply chain management: A systematic review. *PalArch's Journal of Archaeology of Egypt/Egyptology, 18*(7), 811–855.

Shareef, M. A., Dwivedi, Y. K., Kumar, V., Hughes, D. L., & Raman, R. (2020). Sustainable supply chain for disaster management: Structural dynamics and disruptive risks. *Annals of Operations Research, 319*(1), 1–25. https://doi.org/10.1007/s10479-020-03708-3

Shareef, M. A., Dwivedi, Y. K., Mahmud, R., Wright, A., Rahman, M. M., Kizgin, H., & Rana, N. P. (2019). Disaster management in Bangladesh: Developing an effective emergency supply chain network. *Annals of Operations Research, 283*(1), 1463–1487. https://doi.org/10.1007/s10479-018-3081-y

Shukor, A. A. A., Newaz, M. S., Rahman, M. K., & Taha, A. Z. (2020). Supply chain integration and its impact on supply chain agility and organizational flexibility in manufacturing firms. *International Journal of Emerging Markets, 16*(8), 1721–1744. https://doi.org/10.1108/IJOEM-04-2020-0418

Som, J. O., Cobblah, C., & Anyigba, H. (2019). The effect of supply chain integration on supply chain performance. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3454081

Sreedevi, R., & Saranga, H. (2017). Uncertainty and supply chain risk: The moderating role of supply chain flexibility in risk mitigation. *International Journal of Production Economics, 193*, 332–342. https://doi.org/10.1016/j.ijpe.2017.07.024

Srinivasan, M., Srivastava, P., & Iyer, K. N. (2020). Response strategy to environment context factors using a lean and agile approach: Implications for firm performance. *European Management Journal, 38*(6), 900–913. https://doi.org/10.1016/j.emj.2020.04.003

Srinivasan, R., & Swink, M. (2018). An investigation of visibility and flexibility as complements to supply chain analytics: An organizational information processing theory perspective. *Production and Operations Management, 27*(10), 1849–1867. https://doi.org/10.1111/poms.12746

Sweeney, B., & Business, C. (2017). *Lean Six Sigma quick start guide: The simplified beginner's guide to Lean Six Sigma*. Clyde Bank Media.

Takeda, M., Jones, R., & Helms, M. M. (2017). Promoting sense making in volatile environments: Developing resilience in disaster management. *Journal of Human Behavior in the Social Environment, 27*(8), 791–805. https://doi.org/10.1080/10911359.2017.1338173

Tatham, P., & Christopher, M. (Eds.). (2018). *Humanitarian logistics: Meeting the challenge of preparing for and responding to disasters* (3rd ed.). Kogan Page.

Trafimow, D. (2017). Using the coefficient of confidence to make the philosophical switch from a posteriori to a priori inferential statistics. *Educational and Psychological Measurement, 77*(5), 831–854. https://doi.org/10.1177/0013164416667977

Tull, K. (2020). *Cost-effectiveness in humanitarian outcomes: Logistics* (K4D Helpdesk Report 790). Institute of Development Studies.

Um, J. (2017). The impact of supply chain agility on business performance in a high-level customization environment. *Operations Management Research, 10*(1–2), 10–19. https://doi.org/10.1007/s12063-016-0120-1

Vaishnavi, V., & Suresh, M. (2020). Modelling of readiness factors for the implementation of Lean Six Sigma in healthcare organizations. *International Journal of Lean Six Sigma, 12*(2), 175–209. https://doi.org/10.1108/IJLSS-12-2017-0146

Vanpoucke, E., Vereecke, A., & Muylle, S. (2017). Leveraging the impact of supply chain integration through information technology. *International Journal of Operations & Production Management, 37*(4), 510–530. https://doi.org/10.1108/IJOPM-07-2015-0441

Wang, Z., & Zhang, M. (2020). Linking product modularity to supply chain integration and flexibility. *Production Planning & Control, 31*(14), 1149–1163. https://doi.org/10.1080/09537287.2019.1700571

Wayongah, D. W. O. (2019). *Analysis of firm size, leverage and financial performance of non-financial firms in Nairobi Securities Exchange, Kenya* [Unpublished master's thesis]. Maseno University.

Wogi, A. A., Wakweya, S. T., & Tesfay, Y. Y. (2018). Determinants of time-to-under-five mortality in Ethiopia: Comparison of parametric shared frailty models. *International Journal of Biomedical and Clinical Engineering, 7*(1), 1–24. https://doi.org/10.4018/IJBCE.2018010101

Ye, Y., & Yan, H. (2020). Disaster relief supply management. In *Natural hazards-impacts, adjustments & resilience* (pp. 1–18). IntechOpen. https://doi.org/10.5772/intechopen.94008

Zhang, X., Van Donk, D. P., & van der Vaart, T. (2016). The different impact of inter-organizational and intra-organizational ICT on supply chain performance. *International Journal of Operations & Production Management, 36*(7), 803–824. https://doi.org/10.1108/IJOPM-11-2014-0516