Factors Affecting the Humanitarian Supply Chain Performance of the Ethiopian Red Cross Society

BY

Senait Shemelis

A Thesis Submitted to the Addis Ababa University, College of Business and Economics, School of Commerce, for the Partial Fulfilment of the Degree of Master of Arts in Logistics and Supply Chain Management

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Declaration

I, Senait Shemelis, the under signed, declare that this thesis entitled “Factors affecting the humanitarian supply chain performance of the Ethiopian Red Cross Society ”, is my original work and to the best of my knowledge has not been presented for a degree by any other person, and that all the sources of material used for the thesis have been duly acknowledged.

Declared

by

Senait Shemelis

_____

Date & Signature

Statement of Certification

This is to certify that the thesis carried out by **Senait Shemelis** on the topic entitled "*Factors affecting the humanitarian supply chain performance of the Ethiopian Red Cross Society*" is her original work and appropriate for submission for the award of Masters of Art Degree in Logistics and Supply Chain Management.

Advisor

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Factors affecting the humanitarian supply chain performance of the Ethiopian Red Cross Society

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Acronyms and Abbreviations

ANOVA - Analysis of Variance

APICS - American Production and Inventory Control Society

BSC - Balanced Scorecard

CSCMP - Council of Supply Chain Management Professionals

EFQM - European Foundation for Quality Management

ERCS - Ethiopian Red Cross Society

GIS - Geographic Information Systems

HSC - Humanitarian Supply Chain

HSCM - Humanitarian Supply Chain Management

HSCP - Humanitarian Supply Chain Performance

ICRC - International Committee of the Red Cross

ICT - Information and Communication Technology

NGO - Non-governmental Organization

SCOR - Supply Chain Operations Reference

SCO – Supply Chain Operation

SPM - Strategic Profit Model

SPSS - Statistical Package for the Social Sciences

VIF - Variance Inflation Factor

Abstract

Ethiopian Red Cross Society's (ERCS) humanitarian supply chain faces operational inefficiencies that hinder its effective aid delivery. This study aims to evaluate the impacts of technology, standardization, collaboration, and leadership on the ERCS's humanitarian supply chain performance (HSCP), and identify major performance-affecting factors. The research adopted both descriptive and explanatory methods. Data collection involved a structured questionnaire distributed via Google Forms to 116 participants selected through a census method. The population comprises ERCS staff involved in supply chain management across regional offices and headquarters. Data analysis includes quantitative methods like descriptive and inferential statistics, alongside qualitative thematic analysis. Reliability and validity testing were conducted prior to collecting data to ensure the accuracy of the survey tool. The study achieved 81% response rate, indicating high engagement of respondents. Demographic findings showed a diverse workforce across regions and departments. Regarding the HSCP analysis, the result indicates that, among the independent variables, Standardization and Leadership have statistically significant positive impacts on HSCP. Collinearity statistics confirmed good relationships between factors and supply chain performance metrics. The study benefits academia to conduct in-depth studies on how specific aspects of standardization and leadership directly influence HSCP. It aids ERCS to implement and enforce standard operating procedures across all SCOs to improve efficiency. It assists in policy formulation to encourage and facilitate the standardization of HSC processes within ERCS and other aid organizations. Moreover, it helps practitioners to embrace and effectively use technology tools to monitor, manage, and optimize supply chain operations towards ensuring timely and cost-effective aid delivery.

Key words: Humanitarian Supply Chain, Ethiopian Red Cross Society, Technology, Standardization, Collaboration, Leadership

CHAPTER ONE: INTRODUCTION

This chapter provides background information on the research problem, outlines the objectives of the study, presents the research questions, and explains the significance and scope for conducting the research.

1.1. Background of the study

The literature provides various definitions of the supply chain. According to Chen & Paulraj (2004), it can be defined as a network of organizations involved in the production, handling, and distribution of goods and services from the suppliers to the customers. Its management plays a crucial role in effectively managing the flow of goods and services (Guo, 2021). The concept of supply chain resilience is also essential to adapt to disruptions and maintain operational balance in an organization's capacity (Ramirez-Peña *et al.*, 2019).

A humanitarian supply chain (HSC) is a network that supports the transfer of services, supplies, information, and funds among donors, beneficiaries, suppliers, and different parts of humanitarian organizations to deliver aid to those in need (Gizaw & Gumus, 2016). It involves the coordination of activities such as procurement, transportation, warehousing, and distribution of essential goods and services to those in need (Oloruntoba & Gray, 2006). Its key pillars include agility, adaptability, and coordination, which are crucial for enhancing sustainability and expanding the reach of humanitarian efforts (Gheibi *et al.*, 2021). The success of humanitarian activities heavily relies on the efficiency of the supply chain operations (SCO), emphasizing the importance of supply chain optimization to enhance effectiveness and cost-efficiency (Nsereko & Nanzekho, 2022). The importance of HSCs is particularly evident during natural disasters such as floods, where these chains play a crucial role in alleviating the suffering of affected communities (Kovács & Sigala, 2021; Xu *et al.*, 2021). The design and management of HSCs are critical aspects that that require attention to ensure the timely and effective delivery of aid and significantly impact the delivery of aid to those in need (Dubey, 2022).

Supply chain performance measures how effectively and efficiently a supply chain achieves organizational goals like competitiveness, customer satisfaction, and profitability (Gunasekaran *et al.*, 2001). Improving humanitarian supply chain performance requires developing frameworks and indicators for effective measurement and management (Abidi *et al.*, 2014). Various

performance measures are fundamental components in assessing supply chain performance, including cost, customer responsiveness, delivery performance, flexibility, logistics cost, and asset management (Beamon, 1999; Cirtita & Glaser-Segura, 2012). This involves effectively integrating information, utilizing appropriate technologies, defining shared performance metrics, and considering the scope of information within the supply chain (Szymczak *et al.*, 2018).

Factors affecting HSCP are diverse. Flexibility is important for evaluating and improving operational effectiveness (Beamon, 1999). Logistics performance is integral to overall organizational success within the supply chain context (Green *et al.*, 2008). Information technology facilitates streamlined operations and communication (Tripathy *et al.* (2016). Moreover, risk management, quality management, and strategic alignment are also essential for success (Dinh *et al.* (2022). Leadership as critical success factors in addressing challenges such as demand unpredictability and resource limitations is crucial factor (Dubey *et al.*, 2015; Santarelli *et al.*, 2015; Kovács & Sigala, 2021). Supply chain optimization, information security management, and government policies also significantly impact effectiveness (Nsereko & Nanzekho, 2022; Gheibi *et al.*, 2021). Collaborative efforts, information sharing, and strategic decisions further enhance operational efficiency (Sisay & Liku, 2022).

Collaboration, involving interactions among various entities, is crucial for the efficient functioning of the supply chain (Dubey *et al.*, 2017). Standardizing supply chain processes is also vital for improving operational effectiveness and fostering collaboration within humanitarian operations (Blecken, 2010). Optimizing supply chains is also essential for the success of humanitarian activities, with supply chain optimization serving as a critical tool for enhancing efficiency and cost-effectiveness (Nsereko & Nanzekho, 2022). The role of technological advancement has also a role in enhancing supply chain performance (Belhadi *et al.*, 2021). In general, the performance of HSCs is dependent upon a comprehensive understanding and integration of these diverse factors, all aimed at efficiently delivering aid to communities in need.

During humanitarian challenges, collaboration among various international and local organizations in the HSC is essential for achieving an efficient and responsive supply chain in humanitarian aid organizations. Ethiopia frequently faces such diverse humanitarian challenges as recurrent droughts, food insecurity, civil unrest, and health crises such as disease outbreaks,

notably malaria, and others. Effectively addressing these challenges demands the achievement of strong HSCP to ensure the welfare of vulnerable citizens. At the prime position of this effort is the Ethiopian Red Cross Society (ERCS), a key organization that plays an essential role in delivering humanitarian aid to populations affected by natural and man-made disasters within Ethiopia. Collaborating with international development agencies, local government, and non-governmental organizations, ERCS stands as a key organization in responding to diverse crises. This study aims to evaluate the effectiveness of technology, standardization, collaboration, and leadership factors in enhancing the performance of ERCS's HSC operations for aid delivery within Ethiopia. The overall objective is to offer valuable insights for improving performance practices in humanitarian aid delivery efforts.

1.2. Statement of the Problem

The practical gap within the HSCP of ERCS manifests in several operational efficiency challenges. Procurement encounters difficulties due to a sharp rise in prices and goods shortages, demanding repeated bid advertisements, elongating procurement lead times, and inflating advertisement costs (ERCS, 2015). Warehouse management suffers from a shortage of forklift operators, resulting in inefficient arrangements. Moreover, delays plague the technical evaluation process, exacerbated by committee members engaged in field missions and the absence of technical specifications for procured work units (ERCS, 2015). Transportation faces hurdles with escalating fuel prices, making it difficult to secure commercial trucks at previously agreed-upon rates (ERCS, 2015). These operational inefficiencies underscore the need for effective streamline processes and optimize resource utilization within the ERCS's HSC.

The empirical gap in the HSCP of ERCS reveals several deficiencies in understanding and evaluating its activities within the Ethiopian context. Firstly, there is a notable absence of targeted monitoring and evaluations specifically tailored to ERCS's operations, which inhibits the ability to assess the effectiveness of implemented operations (Thomas and Kopczak, 2005). Moreover, there is a concerning neglect of practices aimed at enhancing HSCP efficiencies within ERCS, further exacerbating the operational challenges faced. Moreover, a lack of comprehensive understanding of the dynamics of ERCS's HSC overall operational activities impedes the identification of strengths, weaknesses, and areas for improvement (ERCS, 2019).

Addressing this empirical gap is vital for informing evidence-based decisions and driving improvements in humanitarian aid delivery within Ethiopia.

The theoretical gap within the HSCP sector highlights several crucial deficiencies in its performance. Existing policies suffer from a lack of targeted evaluation and concrete proposals for enhancement, limiting their effectiveness in addressing the complex challenges faced in humanitarian operations (ERCS, 2019). Moreover, there is a need for policies that prioritize timely delivery, resource optimization, and collaboration among stakeholders to ensure efficient and effective humanitarian aid delivery during crises and emergencies. Bridging this theoretical gap requires the development and implementation of strong policy frameworks that address the unique demands of HSC management.

The policy gap within the HSC sector underscores critical deficiencies in policy formulation and implementation. Firstly, there is an absence of concrete policies aimed at enhancing supply chain management practices specifically tailored to the humanitarian sector's needs (ERCS, 2019). This includes addressing key aspects such as collaboration with local organizations, and information sharing, which are essential for enhancing the efficiency and effectiveness of humanitarian operations (Thomas and Kopczak, 2005). Existing policies suffer from a lack of targeted evaluation and concrete proposals for improvement. This is hindering efforts to address the evolving challenges faced in HSCP. Moreover, there is an urgent need for policies that prioritize timely delivery, resource optimization, and collaboration among stakeholders to ensure the seamless delivery of aid during crises and emergencies. Closing this policy gap requires the development and implementation of comprehensive policies and strategies that address the specific needs and challenges of the HSCP sector to ultimately improve its responsiveness.

1.3. Research Questions

The study will address the following research questions:

i) What is the the HSCP of the ERCS?
ii) What are the major factors affecting the HSCP of ERCS?

1.4. Objectives of the Study

The main aim of this research is to evaluate and examine the factors that impact the overall effectiveness of humanitarian supply chains, particularly concentrating on technological advancements, standardization, collaboration, and leadership in the ERCS.

The specific objectives of this study are:

i. To measure the HSCP of ERCS in terms of reliability, responsiveness, agility (flexibility), and supply chain cost.
ii. To identify the primary factors influencing the HSCP of ERCS.

1.5. Significance of the Study

This study holds potential benefits for academicians, policymakers, practitioners, and the ERCS.

Academics stand to benefit significantly from this study as it offers valuable insights into HSC practices within the unique context of the ERCS. By focusing on ERCS's practices, researchers can gain a deeper understanding of the complexities involved in the humanitarian aid in Ethiopia. Furthermore, the study contributes to the academic exploration of HSC dynamics, offering empirical evidence and insights that can enrich existing literature in the field. Overall, academia gains an understanding of effective performance of HSCs through this research.

Policymakers will find practical value in the results generated by this study. By obtaining insights into ERCS's HSCP, policymakers can make informed decisions regarding humanitarian assistance efforts in Ethiopia. The research findings serve as a foundation for developing policies aimed at enhancing the efficiency, responsiveness, and resilience of aid delivery mechanisms. Moreover, policymakers can use the research outputs to foster collaboration between governmental entities and humanitarian organizations like ERCS, leading to more effective coordination and improved outcomes in humanitarian operations.

Practitioners involved in humanitarian aid delivery, including ERCS staff and others, benefit from the results generated by the study. By accessing recommendations tailored to optimize the performance of HSC, practitioners can enhance the efficiency of their aid delivery efforts. The implementation of research-informed best practices can lead to improved coordination, collaboration, and resource allocation, ultimately resulting in more impactful humanitarian

interventions. Practitioners can also use the findings of this study to refine their approaches and adapt to the evolving challenges of delivering aid in Ethiopia.

For the ERCS, the study offers evidence-based best practices for enhancing the organization's humanitarian assistance efforts. By gaining insights into the efficiency of their supply chain practices, ERCS can strengthen its capacity to address the immediate needs of vulnerable populations affected by crises and disasters. Furthermore, the study supports ERCS's role as a key humanitarian organization in Ethiopia by optimizing aid delivery mechanisms and fostering long-term resilience within the communities it serves. Through the implementation of research findings, ERCS can maximize its impact and contribute to positive outcomes for those in need.

1.6. Scope of the Study

Temporally, the study covers past and recent years to capture historical trends and evolving practices implemented by the ERCS in its HSC.

Spatially, the study focuses on ERCS's operations within Ethiopia, including its primary center in Addis Ababa and branches across different regions. It considers variations in infrastructure and logistical considerations across different regions of Ethiopia.

Conceptually, the study examines the role of technological advancements, standardization, collaboration and leadership on the HSCP employed by ERCS to facilitate the delivery of humanitarian aid.

Methodologically, the study draws data to provide an understanding of the existing ERCS's HSC practices. It includes both qualitative and quantitative methods to analyze existing supply chain strategies and propose practical recommendations for improvement.

1.7. Organization of the Study

The structure of this study is as follows. The initial chapter includes the introduction, study background, problem statement, study objectives and basic research inquiries, study significance, and study scope. The second chapter focuses on reviewing literature related to similar topics. The third chapter outlines the proposed methodology, covering data collection and analysis methods. In the fourth chapter, the study presents and analyzes the research findings in detail. The final chapter provides a summary, conclusions, and recommendations based on the study's outcomes.

1.8. Definition of Terms

Collaboration - the cooperative efforts among various stakeholders involved in the humanitarian supply chain to enhance agility and efficiency to meet demand and ensure on-time, in-full delivery.

Flexibility: the agility of a supply chain to respond to unexpected challenges and changes in demand, and to address the demand of the beneficiaries.

Humanitarian Supply Chain Performance - the effectiveness and efficiency of the supply chain activities in achieving humanitarian goals and objectives.

Humanitarian supply Chains - a network that supports the transfer of services, supplies, information, and funds among donors, beneficiaries, suppliers, and different parts of humanitarian organizations to deliver aid to those in need.

Leadership - the process of influencing, guiding, and directing individuals or groups to achieve organizational goals.

Performance Measurement - developing comprehensive frameworks and indicators for assessing supply chain performance and identifying areas for improvement.

Reliability: whether the right product (aid and resources) is delivered to the right affected areas, in the right quantity, at the right time, with the correct documentation, and to the beneficiaries.

Responsiveness - ability to promptly react to crises, adapt to changing conditions, and efficiently deliver aid to affected populations.

Standardization - establishing common procedures, protocols, and criteria to improve operational effectiveness and efficiency across the supply chain.

Technological advancements - the integration of new technologies to enhance the efficiency and effectiveness of humanitarian supply chains.

CHAPTER TWO: RELATED LITERATURE REVIEW

2.1. Theoretical Literature Review

2.1.1. Humanitarian Supply Chain Performance (HSCP)

HSCs, operating in challenging conditions due to disasters that can arise from both natural phenomena and human activities, involve networks of interconnected global organizations (Day *et al.*, 2012). Unlike commercial supply chains, they prioritize adding value to ultimate beneficiaries from affected communities rather than traditional customers (Blanco & Goentzel, 2006)

HSCM encompasses a multifaceted approach involving planning, sourcing, procurement, conversion, and logistics. This process necessitates close coordination with various stakeholders such as suppliers, donors, and beneficiaries, integrating supply management and needs assessment which are crucial aspects of operations within humanitarian organizations worldwide (CSCMP, 2011). Such management is essential for achieving the primary goal of humanitarian organizations: saving lives and alleviating human suffering (Kovacs and Spens, 2007; ICRC, 2010). HSC s, utilized by non-profit or donor-funded organizations, manage the efficient flow and storage of goods from origin to consumption to alleviate the suffering of vulnerable populations (Oloruntoba & Gray, 2006). This involves various tasks like preparedness, planning, procurement, transportation, warehousing, tracking, and inventory management (Oloruntoba & Gray, 2006). Coordinating and managing HSCs are therefore vital to ensure efficient operations and value for money in procurement during emergencies. Governments and NGOs are pivotal actors in HSCs, with governments wielding substantial influence due to their control over political and economic factors. Donors, encompassing both public and private entities, also hold significant sway, leading humanitarian organizations to emphasize accountability and transparency across the supply chain (Wassenhove, 2006).

The HSC aims to save lives and assist beneficiaries amidst irregular demand patterns. Cash donations facilitate procurement, while sorting and prioritizing of unsolicited and in-kind donations reduce bottlenecks. Resources include evacuation vehicles, shelter, and food, with immediate demand requiring nearly zero lead time. The delivery network is ad hoc, and inventory control is challenging due to unpredictable demand. Limited technology and few

software packages hinder logistics data tracking. Performance is gauged by disaster response time, fill rate, and meeting donor expectations. Robust, easily deployable equipment is essential, while high turnover and voluntary staffing pose human resource challenges. Stakeholders encompass donors, governments, NGOs, and the United Nations (Ertem *et al.*, 2010).

HSCs encounter challenges such as insufficient logistics infrastructure and unpredictable shifts in relief supply origins and destinations. Moreover, donors often earmark funds for specific materials or locations, neglecting indirect services like staff training and disaster preparedness (Oloruntoba & Gray, 2006). Therefore, managing HSCs involves not only delivering aid but also addressing donor expectations and stakeholder value.

Humanitarian supply chain management (HSCM) swiftly responds to disasters, aiming to save lives and alleviate suffering. It entails efficiently managing various elements like information, goods, human resources, and infrastructure to minimize the disaster's impact on affected populations (Lijo & Ramesh, 2012. Information technology (IT) plays a crucial role in HSCM as like commercial supply chain management. IT tools such as intranets, extranets, electronic data interchange, videoconferencing, and communication devices like mobile phones and radios are instrumental in this regard. A typical HSC is from donors to consumers, donors and beneficiaries serve as customers, while donors and paid suppliers act as suppliers (Charles *et al.*, 2010; Oloruntoba & Gray, 2009).

HSCP management plays an important role in ensuring the effectiveness of humanitarian efforts by setting strategic goals and directing performance towards those objectives. This involves employing measurement tools to evaluate outcomes and enhance organizational processes (Ariyachandra & Frolick, 2008). Meanwhile, various models and metrics have been developed to measure and manage performance in HSCs, emphasizing factors such as strategic planning, resource management, technology utilization, and supplier relations (Pettit & Beresford, 2009). Despite challenges in adapting traditional models like the balanced scorecard to the dynamic and complex humanitarian context, efforts have been made to develop tailored frameworks such as the Supply Chain Operations Reference Model (SCOR) (Blecken, 2010; Parris, 2013). These endeavors aim to enhance performance measurement and management in humanitarian operations, particularly in emergency relief efforts (Beamon & Balcik, 2008; Schulz & Heigh, 2009; Blecken *et al.*, 2009).

2.1.2 Supply chain performance models

There are various models available for evaluating supply chain performance. Some examples include: *Framework for Logistics Research (FLR), GSCF framework, Strategic Audit Supply Chain (SASC), World Class Logistics (WCL) model, AFNOR model, Balanced Scorecard (BSC), Strategic Profit Model (SPM), American Production And Inventory Control Society (APICS) model, European Foundation for Quality Management (EFQM) Excellence Model, and Supply Chain Operations Reference (SCOR) Model.*

These models have been thoroughly explained by Estampe (2014), as shown below:

Framework for Logistics Research (FLR)

Developed in the 1990s, this model evaluates the alignment of supply chain decisions with a company's strategic goals. It underscores the interconnectedness of performance levels, logistical structure, and competitive strategy, emphasizing the contextual nature of performance assessment. Suitable for both organizational and strategic contexts, the model classifies logistics functions into centralization, formalization, integration, and domains of control, offering a holistic framework for strategic planning and operational effectiveness.

GSCF framework

The Ohio State University (OSU) developed this model in 1994 based on a thorough examination of company practices and supply chain research, this model provides users with the flexibility to choose from three decision-making levels: strategic, tactical, and operational. This enables alignment with the specific needs of the organization, enhancing its adaptability and effectiveness. This model distinctly demonstrates the correlation between supply chain processes and structure, making it applicable across various company types. Organized around seven key processes, including customer relationship management, service management, and product development, it provides a holistic framework for optimizing supply chain management and enhancing overall performance.

Strategic Audit Supply Chain (SASC)

Introduced in 1999 due to a recognized deficit in supply chain management expertise, This model assesses supply chains by examining processes, IT technologies, and organizational structures. It categorizes the supply chain into six key skill areas: customer orientation,

distribution, sales planning, lean production, supplier partnerships, and integrated chain management. While it doesn't explicitly establish connections between supply chain organization and performance, it does correlate competencies with IT technology and chain organization. Primarily focused on internal company performance analysis, this model offers a structured approach to enhancing supply chain management proficiency.

World Class Logistics (WCL) model

The WCL model, pioneered by Michigan State University in the 1990s, evaluates company performance by focusing on its capacity to effectively manage inter-organizational relationships within the supply chain. Utilizing 68 questions, it evaluates supply chain management proficiency, focusing on integration among chain actors and mastery of supply chain concepts. Results are consolidated across companies within the same chain, allowing for analysis of multiple company types along the supply chain, comparison of practices among actors, and classification of performance based on homogeneous performance "types". This model provides a comprehensive framework for understanding and improving supply chain dynamics and performance.

The WCL model, based on research analyzing supply chain performance, identifies key factors contributing to supply chain success, organized into four competency areas.

- *Positioning*- Concentrates on optimizing logistics operations through strategic and structural orientations. It encompasses logistics strategy, supply chain synchronization, infrastructure/network, and human organization.
- *Integration* -Addresses resource implementation for supply chain synchronization, encompassing unification of the supply chain, IT systems, information sharing, compatibility, standardization, simplification, and personnel agreement.
- *Agility* - Emphasizes maintaining a balance between company performance and adaptability to customer needs through relevancy, adaptability, and flexibility.
- *Measurement* - Facilitates performance evaluation by utilizing internal metrics, process assessment, and benchmarking techniques. It encompasses the management of assets, customer service, productivity, and quality.

Thid model evaluates actor integration levels and their mastery of supply chain concepts, providing a comprehensive framework for optimizing supply chain management and performance.

AFNOR model

Developed in 2008 through collaboration between academic and industrial experts, this model presents a structured analysis procedure from company strategy to performance indicator implementation. While it offers a broad framework for reflection, it lacks detailed guidance on the specific analyses needed. Based on Porter's strategic approaches, the model defines logistics processes and develops performance drivers for each. It outlines a flexible procedure without specific constraints, enabling measurement of logistics performance through suggested indicators.

Balanced Scorecard (BSC)

Developed in the 1990s as an alternative to purely financial models, this approach aims to supplement financial performance indicators with functional indicators, striving for equilibrium. Analysis primarily occurs through consensus at the directorial level, aligning measures with company strategy. The model proposes four axes for analysis: customers, financials, internal processes, and innovation-growth, emphasizing the human dimension in performance measurement. Targeted at general management and applied at the strategic level, it employs a top-down approach. The model advocates establishing causal links between each axis of analysis, particularly between the customer and financial axes. Indicators are selected based on company objectives, with measurement balanced to reflect the goals of internal functions and the external environment. The dimensions considered by the BSC are outlined in Table 1. Davidson (2006) discovered that the balanced scorecard was not suitable for the humanitarian sector due to the framework’s rigidity and the complexity of the humanitarian context.

Table 1: Dimensions taken into account by the BSC

Financial perspective	Enhancing shareholder value
Customer Perspective	Delivering value to customers through customer acquisition and retention strategies.
Internal process Perspective	Innovating processes, managing customer interactions, optimizing operations and logistics, and adhering to regulatory and

	environmental standards
Learning and innovation Perspective	Prepared, motivated teams Strategic capabilities, strategic Cultivating skilled and motivated teams, developing strategic capabilities and technologies, and fostering a climate conducive to innovation

Strategic Profit Model (SPM)

Originating from research conducted at Ohio State University in 2000, this model builds upon the DuPont model by integrating actors within the supply chain. It visualizes the interconnectedness between strategic and operational levels through the utilization of financial ratios. The model primarily focuses on strategic and financial application. It focuses on cost drivers such as return on assets and net value. Conceptually, it builds upon the DuPont model and enables external benchmarking through financial ratios.

American Production and Inventory Control Society (APICS) model

The APICS model promotes an organizational management strategy centered around anticipation and resource planning. It emphasizes critical factors driving competitive advantage, such as strategic innovation management, customer service, lead times, costs, efficiency, agility, risk control, and sustainable development. Mainly designed for manufacturing firms, it organizes processes with a primary focus on production. The model incorporates diverse performance management indicators within the realms of production and logistics.

The SCOR model, part of the APICS body of knowledge and developed by the Supply Chain Council (SCC) in 1996, serves to promote the advancement of end-to-end supply chain management. It offers a standardized approach for assessing and describing supply chain processes. Organized into four levels, it outlines generic processes: plan, source, make, deliver, and return. At the second level, process categories align with the company's operational strategy, distinguishing between direct or indirect distribution and make-to-order or make-to-stock approaches. The third level provides detailed specifications for each process category, including inputs and outputs, while the fourth level delineates company-specific procedures.

The model assesses four critical areas: reliability of commercial performance, flexibility/responsiveness, supply chain cost, and capital turnover. Applicable across manufacturing and service industries, it operates at tactical and operational levels, aligning with decisions made in strategic planning. By integrating various chain actors, it fosters operational

synergy. The model establishes a common language among stakeholders by defining fundamental concepts like processes and management modes. Explicitly defined indicators and calculation methods facilitate performance assessment. Process-specific indicators enable benchmarking, facilitating comparisons with other companies or sites.

European Foundation for Quality Management (EFQM) Excellence Model

Introduced in 1992, the EFQM model (Excellence Model) aims to enhance organizational performance by evaluating excellence in strategy implementation. It assesses excellence through factors and results: factors delineate company actions, while results gauge achievements. Evaluation is guided by eight principles, which include customer focus, leadership, process management, employee involvement, innovation, partnership development, and social responsibility. A 50-question questionnaire aids companies in gauging their excellence level across efficacy of processes, product/service improvement, and human resource management. Suited for any company seeking continuous improvement, the model is process-oriented and measures operational results alongside indicators of customer and employee satisfaction, and societal integration.

2.1.2 HSCP model and attributes

Performance assessment within humanitarian organizations lags behind the commercial sector (Lu *et al.*, 2016). Unlike well-established frameworks like the SCOR model and the Balanced Scorecard for commercial enterprises, there is no universally recognized performance measurement framework for humanitarian organizations (Tatham and Hughes, 2011). Consequently, most performance measurement frameworks in this sector are borrowed from commercial metrics (Beamon & Balcik, 2008), although many are found to be inappropriate (Henderson *et al.*, 2002). Sawhill and Williamson (2001) observed a lack of suitable metrics in many cases.

Lockamy and McCormack (2004) highlight the SCOR model as a widely employed framework for assessing and enhancing supply chain performance. It furnishes organizations with an extensive array of processes and best practices to gauge and analyze their supply chain operations. It has been recognized as a powerful tool for describing, analyzing, and improving supply chain processes (Zhou *et al.*, 2011). It has been adapted for performance evaluation in various industries, including humanitarian organizations and healthcare services (Blecken, 2010).

Under the SCOR model, supply chain management encompasses the integrated processes of Plan, Source, Make, Deliver, and Return (Bolstorff & Rosenbaum, 2012).

PLAN: This involves assessing supply resources, enabling demand requirements, planning inventory for distribution and production, and balancing demand and supply to meet sourcing, inventory, and delivery needs.

SOURCE: This includes obtaining, receiving, inspecting, holding, issuing, and authorizing payments for raw materials and purchased finished goods to meet demands.

MAKE: This involves requesting and receiving materials, manufacturing and testing products, and packaging and releasing products.

DELIVER: This process covers order management, generating quotations, configuring products, maintaining customer and product databases, managing accounts receivable, warehouse operations, order consolidation, shipping, transportation, import/export management, and performance verification.

RETURN: This includes handling defective, warranty, and excess returns, authorizing and scheduling returns, inspecting and transferring products, administering warranties, and verifying, disposing, or replacing defective products.

In humanitarian operations, Humanitarian Relief Organizations usually do not engage in manufacturing or handle returned relief items. Consequently, the make and return processes are excluded, and the store process is added to underscore the storage aspect in relief operations (Lu *et al.*, 2016). The store process encompasses activities such as receiving and inspecting goods, as well as storing and dispatching stocked goods. These process elements center on managing performance, information, policy, inventory strategy, capital assets, transportation, physical logistics network, regulatory, and other management processes to facilitate the planning and execution of supply chain activities (Bolstorff & Rosenbaum, 2012).

The fundamental components of quality, time, and cost within humanitarian supply chains aid humanitarian organizations in assessing their performance in terms of ***agility, responsiveness, reliability, and cost-effectiveness*** throughout the entirety of supply chain processes (Lu *et al.*, 2016). Additionally, the SCOR model identifies five essential performance attributes, namely delivery reliability, responsiveness, agility (flexibility), supply chain cost, and asset management

efficiency, as pivotal factors for success in supply chain performance (Bolstorff & Rosenbaum, 2012). These performance attributes and their definitions are outlined in Table 2.

Table 2: Performance attribute, metrics and description (Bolstorff & Rosenbaum, 2012).

Customer Focus	Metric	Description
Supply chain (SC) Reliability & Quality	Perfect Order Fulfillment	How well the supply chain delivers exactly what the customer ordered.
SC Responsiveness & Timeliness	Order Fulfillment Cycle Time	How fast the customer receives their order.
SC Agility	Supply Chain Flexibility & Adaptability	How quickly the supply chain can adjust to meet changing demands.
SC Cost	Supply Chain Management Cost	The total cost of running the supply chain.
SC Asset Management	Cash-to-Cash Cycle Time & Return on Assets	How efficiently the supply chain uses its resources (inventory, equipment, etc.)

The SCOR model, which integrates business processes, metrics, best practices, and technology to enhance the efficiency of supply chain management, serves as a valuable performance measurement tool in humanitarian supply chains (Lu *et al.*, 2016). However, while the SCOR model is an effective performance measure in humanitarian logistics, the asset attribute holds less relevance for Humanitarian Relief Organizations. This is because these organizations are typically asset-light and lack manufacturing facilities or other high-value fixed assets (Lu *et al.*, 2016).

Supply Chain Reliability is a fundamental aspect of logistics processes, emphasizing the importance of maintaining consistent quality standards throughout the supply chain. In humanitarian operations, where timely delivery of aid can mean the difference between life and death, ***Supply Chain Responsiveness*** plays a pivotal role. This aspect focuses on the ability of the supply chain to promptly respond to urgent needs, highlighting the significance of minimizing supply chain response time to ensure swift assistance reaches those in need. ***Supply Chain Cost*** measures serve as indicators of logistics financial performance, providing insights into the efficiency and effectiveness of resource utilization within the supply chain. In addition, ***Agility*** is a critical attribute, particularly in emergency relief operations, as it reflects the supply

chain's capability to swiftly adapt and respond to sudden fluctuations in demand. These factors collectively contribute to the resilience and effectiveness of HSCs to make ensure that aid reaches affected populations efficiently and effectively (Garcia *et al.*, 2012).

Among the various supply chain performance models, the SCOR model stands out due to its comprehensive approach in evaluating and enhancing key performance attributes crucial for efficiently and effectively operating humanitarian supply chains. This study therefore adopts the SCOR model as a performance measurement tool in humanitarian logistics based on its proven effectiveness in this context, as emphasized by Lu *et al*. (2016). However, the study excludes the asset attribute from the SCOR model because it is less relevant to Humanitarian Relief Organizations, whose primary focus is on delivering aid effectively rather than managing physical assets (Lu *et al*., 2016).

2.2. Empirical Literature Review

2.2.1 Factors Affecting HSCP

Technological advancements, standardization, collaboration, and leadership are some of the important factors in enhancing the performance of HSCs. They are essential for enhancing operational effectiveness, efficiency, cooperation, and coordination.

2.2.1.1 Technological Advancements

Technological advancements are one of the essential factors that shape the performance of HSCs. Humanitarian organizations are dependent on innovative technologies to enhance their SCOs and improve their overall performance. The literature underscores the importance of agility, adaptability, and alignment in improving the performance of humanitarian logistics (Dubey *et al.*, 2015). Moreover, information processing technologies have been found to enhance organizational agility within humanitarian supply chains (Dubey *et al.*, 2020). Additionally, the integration of technological solutions can bolster supply chain resilience, as evidenced by evaluations conducted during flood disasters (Xu *et al.*, 2021). Performance measurement holds significant importance in humanitarian supply chains (D'Haene *et al.*, 2015). Critical success factors and performance measurement indicators play a crucial role in evaluating and managing the performance of humanitarian supply chains (Santarelli *et al.*, 2015; Abidi *et al.*, 2014). Furthermore, optimizing supply chains is essential for the success of humanitarian activities,

necessitating organizations to continuously refine their supply chains to enhance efficiency and cost-effectiveness (Nsereko & Nanzekho, 2022).

Incorporating technological advancements can enhance the value of humanitarian supply chains (Abidi *et al.*, 2015). Moreover, the application of interpretive structural modeling can assist in identifying barriers within humanitarian supply chains, aiding in the effective management and dissemination of humanitarian aid (Rahman *et al.*, 2022). Utilizing the 3-R principle (right time, right place, and right material) through technology can help pinpoint shortcomings in relief supply chains' response to natural disasters, providing valuable insights for enhancing supply chain performance (Antai *et al.*, 2015). Altay *et al.* (2023) underscore the significance of innovation in humanitarian logistics and supply chain management, emphasizing how technological advancements improve the efficiency and effectiveness of humanitarian supply chains. Additionally, Dubey *et al.* (2020) discuss the importance of agility in humanitarian supply chains from the perspective of organizational information processing, highlighting the necessity of a theory-driven approach to comprehend how technology contributes to building agility.

Santarelli *et al.* (2015) outline critical success factors for humanitarian supply chains, underlining the strategic utilization of limited resources through technological advancements. Abidi *et al.* (2014) stress the significance of harnessing technology for effective performance management in humanitarian supply chains. Haavisto & Kovacs (2015) introduce a framework for driving innovation upstream in humanitarian supply chains through procurement processes, emphasizing the role of technology in fostering innovation and enhancing overall performance. Additionally, Schniederjans *et al.* (2016) explore the advantages of technologies in promoting collaboration, agility, and trust among supply chain partners in humanitarian contexts. Kabra *et al.* (2017) highlight the importance of understanding technology adoption behavior in the humanitarian supply chain. Chen (2020) delves into the design of sustainable humanitarian supply chains, emphasizing systematic analysis of various factors. Finally, Ali *et al.* (2023) shed light on the impact of humanitarian supply chains on organizational performance, suggesting the necessity for further research on technology adoption and leadership mediation.

Technological advancements encompass a diverse array of tools and systems that aid in the management and execution of supply chain activities within humanitarian contexts. These advancements encompass information and communication technologies (ICTs), geographic

information systems (GIS), data analytics, among others. They facilitate efficiency and effectiveness, coordination and collaboration, resilience and flexibility, as well as risk management, despite encountering challenges such as cost constraints, limited infrastructure, and data privacy concerns. Moreover, ethical considerations surrounding the utilization of data and emerging technologies in humanitarian contexts necessitate careful attention.

Studies by Kabra *et al.* (2017) have highlighted the importance of technology adoption in improving the efficiency and effectiveness of humanitarian operations. The use of technology has been shown to enhance collaboration and trust within HSCs (Schniederjans *et al.*, 2016). Moreover, advancements in information and communication technology have led to significant improvements in the humanitarian aid sector, particularly during crises (Hunt *et al.*, 2016).

Existing literature indicates a low utilization of performance indicators in HSCs suggesting room for improvement in operational efficiency through technological advancements (Santarelli *et al.*, 2015). This gap underscores the necessity for further research to explore how technological advancements can enhance agility in HSCs. Empirical research on cloud computing's utility demonstrates how technological solutions can positively impact supply chain management in humanitarian contexts. Moreover, the adoption of technological innovations is increasingly crucial for humanitarian organizations (Boeck *et al.*, 2023). The evolution of humanitarian logistics as a discipline has been shaped by technological advancements, focusing on sustainability, agility, and innovation (Altay *et al.*, 2021).

$H1_a$: Technological advancement has positive and significant effect on HSCP.

$H0_a$ Technological advancement has no role in HSCP.

2.2.1.2 Standardization

Standardization is one of the key factors affecting the performance of HSCs. It plays a critical role in shaping the performance of HSCs, influencing various aspects such as efficiency. The standardization of data and distribution is crucial for the flexibility of HSCs (Xu *et al.*, 2021). Moreover, standardization in humanitarian logistics is recognized as a means to improve performance through the process of developing and implementing uniform guidelines, protocols, and procedures across supply chain activities (Rahman *et al.*, 2022). The promotion of standardization of supply chain processes is considered a key factor in enhancing operational effectiveness, efficiency, cooperation, and coordination in humanitarian operations (Blecken, 2010). The efficiency of the supply chain is closely linked to the success of humanitarian

activities, making supply chain standardization a critical tool for sustainability and competitiveness (Nsereko & Nanzekho, 2022). In the context of humanitarian operations, standardization encompasses both technical standards (e.g., specifications for relief items, packaging, transportation, etc.) and procedural standards (e.g., coordination mechanisms, information sharing protocols, performance metrics).

Xu *et al.* (2021) emphasize the importance of standardizing data and distribution processes to improve the flexibility of HSCs. This standardization allows for better coordination and response during disaster situations. In the context of HSCs, Santarelli *et al.* (2015) identified critical success factors and performance measurement schemes that are essential for effective operations. Dubey (2022) discusses the challenges, solutions, and frameworks in the design and management of HSCs, shedding light on factors that shape these processes. Moreover, Haavisto & Goentzel (2015) investigate the multi-goal context of measuring HSCP, emphasizing the importance of understanding underlying goals and variables for performance evaluation.

The study conducted by Abidi *et al.* (2014) offers valuable insights into performance measurement and management within humanitarian supply chains, organizing performance indicators across different phases of the supply chain. This structured categorization aids in assessing performance based on specific criteria and pinpointing areas for improvement. Additionally, Nsereko & Nanzekho (2022) underscore the importance of optimizing supply chains in charitable organizations to boost efficiency and competitiveness, critical for the success of humanitarian endeavors. The literature also sheds light on various factors influencing humanitarian supply chain performance, including standardization and supply chain innovation (Santarelli *et al.*, 2015). Moreover, Oloruntoba & Gray (2006) discuss the application of best practices from traditional business supply chains to enhance humanitarian aid supply chains. Furthermore, Altay *et al.* (2023) highlight the significance of innovation and standardization in humanitarian logistics and supply chain management.

In addition, the literature emphasizes the significance of performance measurement in humanitarian logistics. Schiffling & Piecyk (2014) emphasized the necessity of adopting a customer-oriented approach as a standard for performance measurement in humanitarian supply chains. Similarly, Abidi *et al.* (2014) conducted a systematic literature review on performance management in humanitarian supply chains, providing a classification of performance measurement indicators such as standardization.

By standardizing data, logistics and transport, communication and coordination protocols, training and capacity building, monitoring and evaluation frameworks, supply chain visibility and transparency, cost-effectiveness, etc., organizations can improve operational effectiveness, efficiency, cooperation, and coordination in humanitarian operations (Blecken, 2010). This standardization is essential for ensuring that limited resources are used strategically and that logistics skills contribute positively to humanitarian logistics performance (Santarelli *et al.*, 2015).

Standardization promotes efficiency; contributes to the delivery of high-quality humanitarian assistance and enhances accountability within supply chains; enhances the resilience and adaptability of HSCs in the face of complex and evolving crises; and fosters collaboration and coordination among diverse stakeholders involved in HSCs, including aid agencies, governments, NGOs, and local communities. Despite its benefits, standardization in HSCs faces challenges such as the complexity of humanitarian crises, cultural and contextual differences, limited resources and capacity, and the need for flexibility in response to dynamic situations.

By standardizing supply chain processes, operational effectiveness, efficiency, cooperation, and coordination in humanitarian operations can be improved (Blecken, 2010). This highlights the critical role that standardization plays in improving overall performance in HSCs. This standardization not only enhances effectiveness but also contributes to better performance measurement practices (Abidi *et al.*, 2014). They conducted a systematic literature review, resulting in the classification of 94 indicators tailored specifically to HSCP measurement. This classification provides a foundation for organizations to assess and improve their performance. By identifying and categorizing performance measurement indicators across different supply chain phases, gaps and challenges can be addressed to enhance overall performance (Abidi *et al.*, 2014). This standardization is essential as it provides a structured framework for managing HSCs by ensuring consistency and reliability in operations (Dubey, 2022). Moreover, standardization can enhance the transparency of operations and showcase a higher level of accountability, meeting the criteria set by donor agencies (Lwin *et al.*, 2022). The study by Oloruntoba & Gray (2006) also emphasizes the importance of standardization to work hand in hand with agility and create a more responsive and adaptable supply chain model. Dubey (2022) highlights that the design and management of HSCs are influenced by various factors, including standardization. Understanding these factors is essential for optimizing supply chain performance. Existing

studies have shown a low utilization of performance indicators in HSCs, highlighting the need for improved operational efficiency (Santarelli *et al.*, 2015).

$H1_b$: Standardization has a positive and significant effect on the HSCP.

$H0_b$: Standardization has no role on HSCP.

2.2.1.3 Collaboration

Collaboration stands as a fundamental driver of success in humanitarian supply chains, fostering stakeholders' joint efforts towards common objectives and effective aid delivery to crisis-affected populations. Research underscores the pivotal role of collaboration in humanitarian supply chains (Dubey *et al.*, 2017; Xu *et al.*, 2021). In contexts where resources are often scarce and time is critical, collaboration plays a vital role in ensuring efficient coordination and fostering trust among stakeholders (Dubey *et al.*, 2017). This collaboration is essential for achieving shared goals and responding promptly to crises (Dubey *et al.*, 2017). In humanitarian supply chains, collaboration entails partnerships among various stakeholders, including governments, aid agencies, NGOs, the private sector, and local communities, to pool resources, share information, and leverage expertise in addressing the complex challenges of emergency aid delivery. Moreover, the literature emphasizes that collaboration in humanitarian supply chains differs from traditional supply chains due to the unique uncertainties and challenges inherent in humanitarian settings (Sabri *et al.*, 2019). The imperative for coordination and collaboration is particularly pronounced in humanitarian contexts, where the swift and effective delivery of aid is paramount (Sabri *et al.*, 2019). Studies have also highlighted that the absence of collaboration and coordination among organizations in the humanitarian sector poses challenges at the network level (Abidi *et al.*, 2014).

Moreover, the use of digital technologies has been identified as a facilitator of collaboration in HSCs (Dubey, 2022). Leveraging technologies can enhance information visibility and promote collaboration among stakeholders involved in humanitarian operations (Dubey, 2022). Furthermore, collaborative research methodologies have been proposed as a means to address uncertainties and improve coordination in HSCs (Sabri *et al.*, 2019). Emphasizing the importance of collaborative research methodologies in HSCs highlights the need for structured processes tailored to the humanitarian domain (Sabri *et al.*, 2019). Furthermore, Schneiderjans *et al.* (2016) discuss the significance of cloud computing in fostering collaboration within HSCs, providing a validated model depicting these relationships. The roles of stakeholder engagement,

information sharing, coordination mechanisms, capacity building, risk management, resource mobilization, etc. in HSCs are necessary to improve coordination and collaboration within supply chains (Besiou & Wassenhove, 2020; Sabri *et al.*, 2019).

Collaboration enhances coordination and integration and facilitates resource mobilization; fosters innovation and adaptability in HSCs, helps in sharing knowledge, best practices, and lessons learned; promotes community engagement and participation in humanitarian response efforts, enhances the resilience and sustainability of HSCs by fostering long-term partnerships and capacity-building initiatives.

Collaboration plays a crucial role in enhancing the performance of HSCs. Research by Oloruntoba & Gray (2006) emphasizes the importance of agile supply chains in humanitarian aid, highlighting the need for empirical studies to validate the agile HSC model (Oloruntoba & Gray, 2006). Moreover, Dubey *et al.* (2020) discuss the significance of organizational information processing and relational views in building agility within HSCs, stressing the need for theory-driven approaches to understand key factors influencing agility (Dubey *et al.*, 2020).

Furthermore, point out that the triple-A supply chain model, focusing on agility, adaptability, and alignment, is prominently observed in disaster relief scenarios, underscoring the importance of rapid response, adaptability to dynamic environments, and effective collaboration with partners (Kovacs & Sigala, 2021). Sabri *et al.* (2019) examined collaborative research methodologies in HSCs and proposed a structured process comprising eight phases tailored for the humanitarian domain (Sabri *et al.*, 2019).

Moreover, Larson (2021) delves into the convergence of security, sustainability, and collaboration in humanitarian logistics and supply chain management, shedding light on the evolving dynamics of collaboration within the sector. Adem *et al.* (2018) investigate the relevance of supply chain collaboration in the humanitarian sector as a means to achieve competitive advantage, stressing the importance of comprehensive scrutiny of collaborative frameworks. The literature emphasizes the importance of agility, adaptability, and alignment in HSCs (Kovacs & Sigala, 2021). Studies have highlighted the need for empirical research to test models of agile HSCs (Oloruntoba & Gray, 2006). In addition, the role of key factors in building agility within HSCs has been explored from an organizational information processing perspective (Dubey *et al.*, 2020).

Furthermore, collaborative research methodologies have been proposed to enhance HSCs (Sabri *et al.*, 2019). The significance of collaboration, cooperation, and coordination in humanitarian supply chains has been highlighted as crucial for enhancing their efficiency and effectiveness (Banomyong & Julagasigorn, 2017).

H1c: Collaboration positively and significantly impacts the performance of HSCs.

H0c: Collaboration has no role in HSCP.

2.2.1.4 Leadership

Effective leadership is a key driver in shaping humanitarian aid supply chains as it plays a crucial role in shaping the performance of HSCs, influencing various aspects such as coordination, decision-making, innovation, and resilience in driving the success of humanitarian operations and supply chain networks (Fiorini *et al.*, 2021; Dubey, 2022). In the context of disaster relief, the application of "intergroup leadership theory" can provide valuable insights into fostering collaboration among members within HSCs (Dubey *et al.*, 2020). Crisis leadership theory also highlights the significance of leaders recognizing and respecting individual identities, being open to innovative ideas, and effectively managing emergency SCOs during crises (Dubey, 2022). Leadership is identified as a critical success factor influencing the performance of humanitarian logistics, with its impact mediated through factors like agility, adaptability, and alignment within supply chains (Dubey *et al.*, 2015). These authors have identified leadership as a critical success factor in humanitarian operations and supply chain networks. It is considered a mediating factor that influences the performance of HSCs (Ali *et al.*, 2023). In the context of humanitarian logistics, it has been recognized as a significant factor that impacts performance (Dubey *et al.*, 2015). Furthermore, the significance of leadership support has been highlighted as one of the enablers with high driving power in the implementation of HSCM (Agarwal *et al.*, 2020).

Leadership qualities such as crisis management, decision-making, and fostering innovation are essential in ensuring the resilience and efficiency of HSCs (Dubey, 2022). Furthermore, leadership plays a crucial role in managing supply chain disruptions by drawing parallels between pandemic response supply chains and HSCs (Kovacs & Sigala, 2021).

In terms of performance measurement, leadership is integral to driving success. While performance measurement remains an area of ongoing research in HSCs, agility has been acknowledged as a key component in evaluating performance (Schniederjans *et al.*, 2016). The role of leadership in crisis situations is emphasized, underscoring the importance for leaders to

be open to innovative communication skills, collaboration and team building, decision-making authority, resource mobilization, accountability, etc. for managing emergency supply chains effectively (Dubey, 2022).

Effective leadership fosters collaboration, builds trust, inspires commitment, and drives continuous improvement in SCOs. In general, it provides a clear vision and strategic direction for HSC operations; influences decision-making processes in HSCs; fosters collaboration and teamwork among diverse stakeholders involved in HSCs; plays a critical role in managing change and promoting adaptability in HSCs; enhances the resilience and empowerment of HSCs. Despite its benefits, it faces challenges such as resource constraints, cultural and contextual differences, power dynamics, and the complexity of coordinating diverse.

Leadership emerges as a critical success factor in humanitarian supply chain operations and networks for effectively responding to crises and delivering aid to affected populations (Dubey *et al.*, 2015). Effective leadership entails the development of skills such as relationship management, education, research abilities, and performance measurement skills for supply chain coordinators in humanitarian relief chains (Fiorini *et al.*, 2021). According to Alaswad & Salman (2020), effective leadership is fundamental in addressing the complexities and uncertainties inherent in humanitarian supply chains, ensuring the efficient and timely delivery of aid to those in need. In the realm of supply chain leadership, Mokhtar *et al.* (2019) emphasized the significance of supply chain leadership and called for further research in this area. However, Prabhu & Srivastava (2022) highlight the absence of literature reviews on the role of leadership in supply chain management, indicating a gap that needs to be addressed. Gosling *et al.* (2017) highlighted the significance of leadership in promoting sustainability and proposed a conceptual framework on how supply chain leadership can drive sustainable practices within supply chains,

Several studies highlight the importance of transformational leadership in HSCs by emphasizing leaders' abilities to inspire, motivate, and empower their teams during crises. According to Phung *et al.* (2022), transformational leadership is essential for integrating supply chain risk management and downstream performance as it contributes significantly to supply chain performance. In support of this, the work of Ojha *et al.* (2018) also suggests that transformational leadership influences supply chain organizational learning and ultimately impacts supply chain performance, with challenges such as coordination, and resource constraints (Ojha *et al.*, 2018).

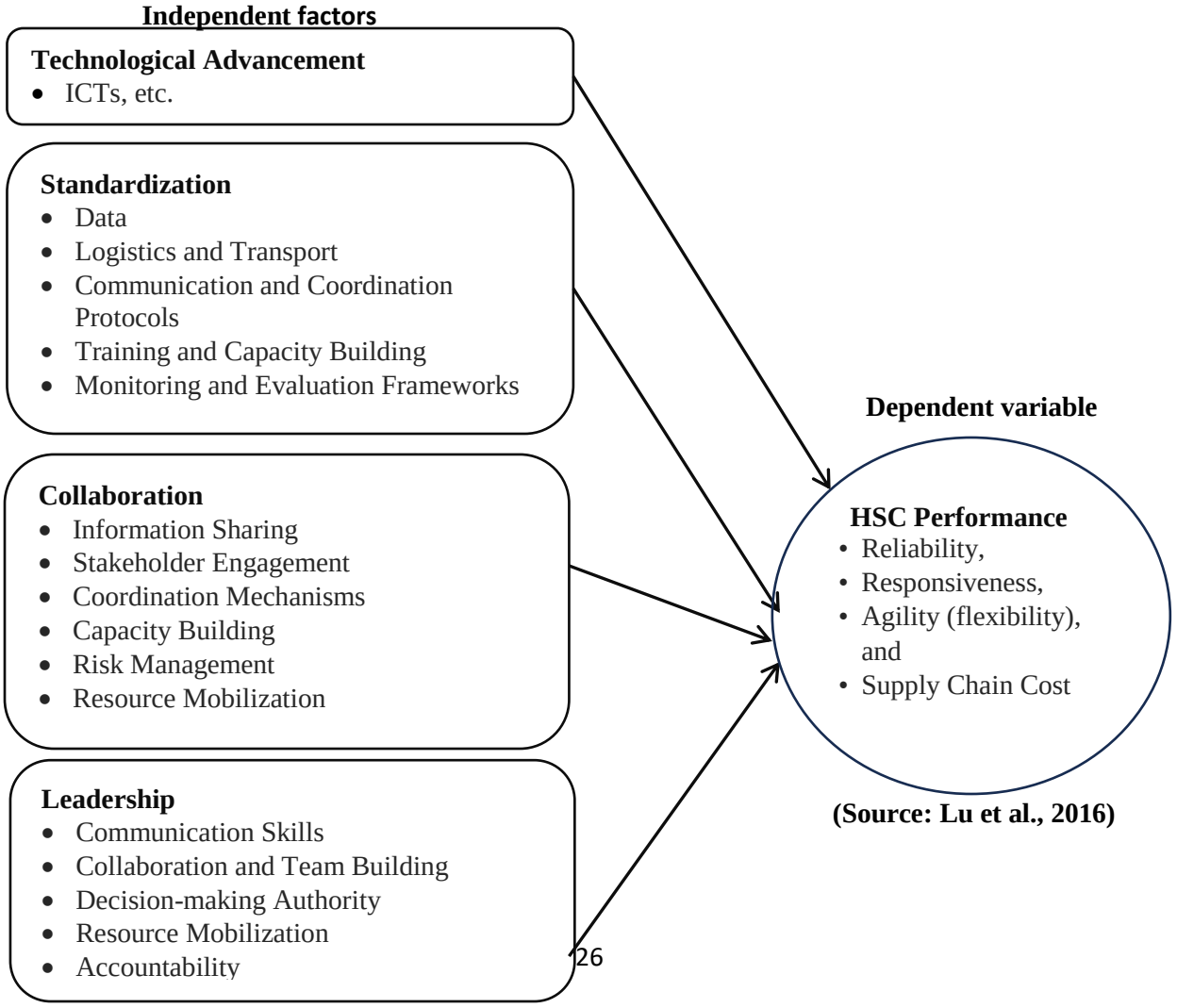
Moreover, the study by Shaheen *et al.* (2021) evaluates leadership styles in supply chain disruptions. They clarified the importance of leadership in managing unforeseen events that can impact supply chain performance. Nichols *et al.* (2020) also discuss transformational leadership in a supply chain management perspective by emphasizing the contextual influence on the efficacy of different leadership styles. The components of humanitarian supply chain resilience encompass organizational capacity, collaboration, flexibility, and humanitarian culture, all of which are influenced by leadership decisions and actions (Michel *et al.*, 2023). Moreover, the impact of HSCs on non-governmental organizations' performance is moderated by organizational culture, with leadership playing a significant role in mediating this relationship (Ali *et al.*, 2023).

H1d: The effectiveness of leadership positively and significantly influences the performance of HSCs.

H0d: Leadership has no role in HSCP.

2.3. Conceptual Framework

This conceptual framework outlines the factors affecting HSCP.



(Source: Lu et al., 2016)

2.4 Hypotheses Formulation

From the empirical literature review, it is evident that technological advancements, standardization, collaboration, and leadership are crucial factors influencing the performance of Humanitarian Supply Chains (HSCs). These factors enhance operational effectiveness, efficiency, cooperation, and coordination within humanitarian operations.

Technological innovations play a pivotal role in enhancing HSC performance. Research emphasizes their contribution to agility, adaptability, and organizational alignment, essential for improving humanitarian logistics (Dubey et al., 2015; Xu et al., 2021). Studies underscore the benefits of information processing technologies and their role in bolstering supply chain resilience during crises (Dubey et al., 2020; Antai et al., 2015). However, challenges such as cost constraints and infrastructure limitations may hinder their full utilization.

Standardization emerges as a critical factor in HSCs, promoting efficiency and effectiveness through uniform guidelines and protocols (Xu et al., 2021; Rahman et al., 2022). It supports coordination across supply chain activities and enhances performance measurement practices critical for evaluating and managing humanitarian operations (Santarelli et al., 2015; Abidi et al., 2014).

Effective collaboration among stakeholders is fundamental in HSCs, facilitating resource pooling, information sharing, and expertise leveraging for efficient crisis response (Dubey et al., 2017; Schniederjans et al., 2016). Studies highlight the unique challenges of collaboration in humanitarian contexts and underscore its role in enhancing operational coordination and effectiveness (Sabri et al., 2019; Besiou & Wassenhove, 2020).

Leadership plays a pivotal role in shaping HSC performance by fostering coordination, innovation, and resilience (Fiorini et al., 2021; Dubey et al., 2020). Effective leadership is crucial for navigating complexities and uncertainties inherent in humanitarian operations, influencing organizational culture and driving sustainable practices within supply chains (Alaswad & Salman, 2020; Michel et al., 2023).

Based on the insights drawn from the empirical literature, the following hypotheses were formulated to explore the relationships between factors such as Technological advancement, Standardization, Collaboration and Leadership and HSC performance:

$H1_a$: Technological advancement has positive and significant effect on HSCP.

H0a Technological advancement has no role in HSCP.

H1b: Standardization has a positive and significant effect on the HSCP.

H0b: Standardization has no role in HSCP.

H1c: Collaboration positively and significantly impacts the performance of HSC.

H0c: Collaboration has no role in HSCP.

H1d: The effectiveness of leadership significantly influences the performance of HSC

H0d: Leadership has no role in HSCP.

CHAPTER THREE: RESEARCH METHODOLOGY

This section addresses the methodologies and modalities employed in collecting data concerning the factors influencing the HSCP at the ERCS. The chapter is organized into segments detailing the study area, research design, research approach, data sources, data collection methods, population, data analysis and presentation methods, reliability and validity testing, and ethical considerations.

3.1. Description of the Study Area

The focus of the study revolves around the ERCS, a humanitarian organization established in 1935 in response to Italian aggression in Ethiopia. It operates in accordance with the principles of the International Red Cross and Red Crescent Movement, which encompass humanity, impartiality, neutrality, independence, voluntary service, unity, and universality.

ERCS is mandated to provide various humanitarian services and assistance to the most vulnerable populations in Ethiopia, including disaster response and preparedness, health services, first aid and ambulance services, water and sanitation initiatives, and community-based programs focused on resilience-building and capacity development.

The society operates at the national, regional, and community levels, with a network of volunteers and staff dedicated to delivering services and support across the country. The ERCS engages in collaborations with diverse stakeholders, comprising government agencies, non-governmental organizations, and international partners, to address humanitarian needs and foster the well-being of communities. In addition to its emergency response and disaster management activities, ERCS also engages in advocacy, awareness-raising, and community mobilization efforts to promote humanitarian principles, human rights, and social inclusion. The organization plays a vital role in contributing to Ethiopia's efforts to achieve sustainable development and improve the lives of its citizens.

As an auxiliary to the government and an independent humanitarian organization, the ERCS has fostered diverse partnerships. The humanitarian diplomacy and communication department enhances ERCS's image and communication with stakeholders. The Resource Mobilization Department plays a vital role in mobilizing resources for humanitarian efforts. Reorganized in 2014, it now consists of Disaster Preparedness and Response (DPR) as well as Disaster Risk Reduction (DRR) departments.

3.2. Research Design

The study employed both descriptive and explanatory research designs to explore factors affecting HSCP. Data collection involveed administering a structured questionnaire via Google Forms to approximately 116 participants, selected through census method. The questionnaire comprised multiple-choice and Likert-scale items, covering factors affecting HSCP such as technological advancements, standardization, collaboration, leadership. Quantitative analysis using statistical software like SPSS and Excel were conducted to analyze the collected data.

3.3. Research Approach

The study integrated a qualitative approach to capture participants' perceptions and experiences regarding supply chain challenges and opportunities. Primarily, qualitative methods were employed to investigate the factors affecting HSCP, concentrating on objective measures of various supply chain practices. Statistical analysis of both qualitative and quantitative data facilitated the identification of key performance factors and their influence on humanitarian supply chain operations. Through the combination of quantitative and qualitative approaches, this study aims to offer a holistic understanding of humanitarian supply chain performance at the ERCS, with the goal of enhancing humanitarian logistics management.

3.4. Source of Data

Two forms of data, primary and secondary data, were gathered. Primary data aimed to acquire firsthand insights into the factors influencing the performance of the HSC in the ERCS. Secondary data were sourced from both published and unpublished documents.

3.5 Method of data collection

Data collection for the survey utilizeed Google Form

(https://docs.google.com/forms/d/1GXtWwBs0l_y9CzQyGHyJs2EMX17SGhwC9HTJ-Eut4A8/edit)

The form offers flexibility and accessibility for participants to respond at their convenience from any location with internet access. Participants received emails with a direct link to the questionnaire, emphasizing the significance of their input in enhancing ERCS's supply chain management. Reminder notifications may be sent to encourage participation, and participants were informed of the estimated 15-20 minute completion time. The structured survey format

were submitted directly through Google Forms. Secondary data collection involved reviewing literature on factors influencing HSCP in the ERCS.

3.6 Population

Respondents were selected from different locations within the ERCS. Specifically, the Census Method was employed to include all 116 respondents who hold roles and responsibilities in HSCM practices within the ERCS, encompassing individuals from each of the eleven regional offices across Ethiopia and the headquarters in Addis Ababa. This approach captures data from individuals with relevant expertise and experience, aligning closely with the research objectives and supporting the relevance and validity of the study findings.

3.7 Method of data analysis and presentation

To analyze the data obtained from the questionnaire survey, a blend of qualitative and quantitative methodologies was applied. Qualitative analysis entailed thematic analysis to identify recurring themes and patterns within the closed-ended responses. This systematic approach to coding the data allowed for a deeper understanding of respondents' perceptions and experiences. Quantitative analysis involved coding the survey responses and utilizing SPSS version 25 for examination. Descriptive statistics, such as frequencies, percentages, means, and standard deviations, were employed to provide an overview of the responses, facilitating the comprehension of their distribution and the identification of trends. In addition, inferential statistics such as regression analysis were utilized to investigate the relationships between variables and to assess significant differences between groups. Accordingly, individual regression analyses were performed for each of the four dependent variables: Reliability, Responsiveness, Flexibility, and Supply Chain Cost. Furthermore, an aggregate regression analysis was conducted to examine the collective impact of the independent variables (Technological Advancements, Collaboration, Standardization, and Leadership) on overall humanitarian supply chain performance.

Diagnostic tests were conducted to ensure data quality, while reliability and validity checks were performed to verify that the questionnaire accurately measured the intended constructs.

3.8 Reliability and validity test

Cronbach's alpha serves as a crucial metric for assessing the internal consistency and reliability of questionnaires and scales across various fields of study, commonly integrated into statistical analysis software like SPSS (Huong *et al.*, 2020). It's often utilized to compute correlation values among responses in assessment tools (Mun *et al.*, 2021).

In evaluating the reliability of the structured questionnaire employed in the study on factors influencing humanitarian supply chain performance, internal consistency reliability was scrutinized to gauge how consistently items within each construct of the questionnaire measure the same underlying concept. This process ensures that the questionnaire items reliably measure the intended aims. Prior to the survey, a pilot study was conducted on the questionnaires by distributing them to logistics and supply chain staff as a pilot scale for its reliability. The value of Cronbach's alpha (α) was calculated. For a scale to be considered reliable, Cronbach's Alpha should exceed 0.70, while any scale with a value below this threshold should be excluded.

To assess the reliability of the survey instrument, Cronbach's Alpha reliability analysis was conducted on several variables. The survey comprised 5 items aimed at gauging HSCP among respondents. Each item was rated on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Data were gathered from a sample of 5 respondents from the headquarters office. Cronbach's Alpha is widely utilized to gauge the internal consistency of a set of items, indicating how effectively the items in a scale are positively correlated with each other. The Cronbach's Alpha values for each variable are outlined in Table 3. These values reflect the reliability of the scales utilized to assess various constructs linked to supply chain management. Overall, the validity tests ensured that the questionnaire precisely measures the intended objectives concerning factors impacting HSCP.

Table 3: Reliability and validity test statistics resulting from the pre-test survey

No.	Variable	Cronbach's Alpha Value	Items Cronbach's Alpha
1	Techno local Advancements	.802	3
2	Standardization	.900	3
3	Collaboration	.848	3

4	Leadership	.825	3
5	Reliability	.915	5
6	Responsiveness	.714	5
7	Flexibility	.824	5
8	Supply Chain Cost	.758	5
Overall reliability		**.861**	**32**

Source: Self-conducted survey, 2024

The outcomes of the reliability analysis reveal that the majority of variables within the survey instrument exhibit strong to outstanding internal consistency, as evidenced by Cronbach's Alpha values spanning from 0.714 to 0.915. The high reliability scores for variables such as Standardization (0.900) and Reliability (0.915) suggest that these constructs are well-represented by their respective items. The Responsiveness variable, while still acceptable, has the lowest Cronbach's Alpha value (0.714). Overall, the survey instrument is reliable and can be confidently used for further analysis and interpretation in the study of supply chain management.

3.9. Questionnaire validity testing

Statistical testing for the validity of the questionnaire was conducted using Pearson's Correlation Coefficient on a sample size of 94 respondents. Each question of the questionnaire was examined individually. The correlation results were found to be significant at the 0.01 level (2-tailed) for all questions. The critical value for 92 degrees of freedom (DF) at the 0.01 significance level is 0.2645, according to the Table of Critical Values for Pearson's Correlation Coefficient. The validity test shows that all the observed correlation values are greater than the critical value of 0.2645, demonstrating that the questionnaire is valid (See Annext 1).

3.10. Ethical Considerations

The research prioritizes the rights of individuals involved, safeguarding confidentiality, anonymity, voluntary participation, and informed consent. Utilizing Google Forms as the survey platform ensures a high level of security aligned with Google's rigorous privacy policies. Emphasizing the importance of configuring Google Form settings to restrict access and anonymize responses, the researcher commits to handling participants' data with the utmost care by adhering to established privacy standards and reinforcing response confidentiality. Any necessary approval from ERCS were sought before starting data collection.

CHAPTER FOUR: RESULTS AND DISCUSSION

This chapter addresses the study's findings derived from analyzing the data gathered from 11 regional offices and the ERCS headquarters. The findings are articulated through frequency tables, cross-tabulations, and the outcomes of multiple regression analysis techniques. The analysis and interpretation of the data were guided by the research objectives stated in the introduction section.

4.1. Response Rate

The response rate is one of the vital measures of the data quality and reliability in survey research (Fan & Yan, 2010). The response rate of 81% observed in this study signifies a good level of engagement and commitment among the respondents towards their contribution. Out of the 116 questionnaires disseminated to potential respondents to the ERCS staffs both in the regions and the head quarter, the return of 94 fully completed questionnaires reflects a strong willingness to actively participate in the study. This high response rate not only demonstrates the respondents' interest in the research topic but also suggests a genuine effort on their part to provide accurate and valuable data. Such a response rate supports the credibility and reliability of the study findings. While a universally accepted standard for an acceptable response rate does not exist, researchers frequently strive for a response rate of 60% to 70% to guarantee the data's reliability and validity (Nulty, 2008).

4.2. Demographic Profile of the Respondents

The survey results indicate a diverse range of educational qualifications among the respondents (Table 4). The majority hold advanced degrees, with 54.3% (n = 51) having obtained a Master's degree or higher, predominantly male (n = 40 males, n = 11 females). Respondents with a Bachelor's degree constitute 40.4% (n = 38) of the sample, also with a notable male majority (n = 25 males, n = 13 females). A small fraction, 5.3% (n = 5), possess a diploma, consisting of 1 male and 4 females. In total, 66 males and 28 females participated in the survey, amounting to 94 respondents.

The respondents' years of experience at the ERCS vary significantly. A substantial portion, 42.6% (n = 40), have between 1 to 5 years of experience, including 27 males and 13 females. Those with 6 to 10 years of experience account for 27.7% (n = 26), with a majority of males (n =

16) compared to females (n = 10). Respondents with over 10 years of experience constitute 21.3% (n = 20), predominantly male (n = 17 males, n = 3 females). A smaller segment, 8.5% (n = 8), has less than 1 year of experience, consisting of 6 males and 2 females. This data illustrates a varied distribution of experience levels among the respondents.

The distribution of respondents across different departments or work units underscores the diverse roles within the ERCS. The largest group, representing 16.0% (n = 15), works in the HSC department. This is followed by the Disaster Risk Management department, which includes 13.8% (n = 13) of respondents. The Project Manager unit accounts for 12.8% (n = 12), while the Field Officer and DVM units comprise 10.6% (n = 10) and 9.6% (n = 9) of respondents, respectively. Other notable departments include Administration and Finance, Delegation Officer, and Disaster Risk Reduction, each represented by 8.5% (n = 8) of respondents. Additionally, 11.7% (n = 11) belong to other unspecified units.

Table 4: The demographic attributes of individuals participating in the survey

		Male	**Female**	**Frequency**	**Percent**
Level of Education	Diploma	1	4	5	5.3
	Bachelor's Degree	25	13	38	40.4
	Master's and above Degree	40	11	51	54.3
	Total	**66**	**28**	**94**	**100**
Years of Experience at ERCS	Less than 1 year	6	2	8	8.5
	1-5 years	27	13	40	42.6
	6-10 years	16	10	26	27.7
	Over 10 years	17	3	20	21.3
	Total	**66**	**28**	**94**	**100.0**
Department/Work Unit	Admin and Finance	4	4	8	8.5
	Project Manager	7	5	12	12.8
	Humanitarian supply chain	10	5	15	16.0

	Disaster Risk Management	10	3	13	13.8
	Field Officer	9	1	10	10.6
	DVM	9	0	9	9.6
	Deligation Officer	5	3	8	8.5
	Disaster Risk Reduction	8	0	8	8.5
	Other	4	7	11	11.7
	Total	**66**	**28**	**94**	**100.0**
Regional branch	Afar	4	0	4	4.3
	Tigray	7	4	11	11.7
	Benishangul	5	4	9	9.6
	Amhara	5	5	10	10.6
	Dire Dawa	4	1	5	5.3
	Head Quarter	16	6	22	23.4
	Sidama	5	0	5	5.3
	Harari	3	0	3	3.2
	Oromia	7	4	11	11.7
	Gambella	2	1	3	3.2
	SNNP	4	1	5	5.3
	Somali	4	2	6	6.4
	Total	**66**	**28**	**94**	**100.0**

Source: Self-conducted survey, 2024

Respondents are spread across various regional branches of the ERCS, with the largest concentration at the Head Quarter, representing 23.4% (22 individuals). The Tigray and Oromia regional branches each account for 11.7% (11 individuals), followed by Amhara at 10.6% (10 individuals). The Somali region includes 6.4% (6 individuals), and Sidama, SNNP, and Dire Dawa each hold 5.3% (5 individuals). Other branches include Afar accounted for 4.3% (n = 4 individuals), Benishangul represented 9.6% (n = 9), and both Harari and Gambella each comprised 3.2% (n=3) of the total sample. Although the demographic makeup of respondents can be influenced by the timing and method of survey administration (Leone *et al.*, 2022),

grasping the characteristics of survey respondents is crucial for ensuring the reliability and validity of research outcomes (Berinsky *et al.*, 2012). This distribution in this study indicates a widespread presence of respondents across the various regions. In general, the survey data reveals a diverse and experienced workforce within the ERCS, with varying levels of education and distribution across multiple departments and regional branches.

4.3. Factors affecting HSCP:Descriptive analysis

Managing HSCs are important to improve the performance of aid organizations in delivering timely and effective assistance to communities in need (Peter, 2020). Yet, various factors affect HSCP (Nsereko & Nanzekho, 2022). This study examines how various factors impact the performance of the humanitarian supply chain at the ERCS, as indicated in Table 5.

Table 5. Mean Range Interpretation (Best, 1997)

1.00-1.80	Very Uninfluential
1.81-2.41	Uninfluential
2.42-3.23	Moderately Influential
3.24- 4.03	Influential
4.04-5.00	Very Influential

4.3.1. Technological Advancements

Table 6 displays information on the influence of various technological measures on the efficiency of the humanitarian supply chain at the ERCS. The evaluated indicators cover the utilization of GPS for monitoring aid shipments, the implementation of information communication technology (ICT) for stakeholder coordination, and the integration of ICT for ensuring inventory management accuracy. Responses are classified into five levels, accompanied by respective mean scores and standard deviations. The mean values and standard deviations in each column signify the average rating and the dispersion of responses for each inquiry.

Table 6: Impact of Technological Advancements on HSCP

Indicators	SD	D	N	A	SA	Mean	Stdv
ERCS uses GPS to make tracking aid deliveries better	2	27	24	39	2	3.13	0.93
ERCS practices information communication technology (ICT) to coordinate stakeholders.	3	15	30	45	1	3.28	0.86
ERCS uses ICT for inventory management accuracy.	3	12	33	45	1	3.31	0.83
					Mean Avarage	**3.24**	

NOTE: SD- Strongly Disagree, D- Disagree, N-Neutral, A- Agree, SA- Strongly Agree

Source: Self-conducted survey, 2024

Interpreting the mean scores in relation to the Mean Range Interpretation from Table 5, the findings indicate that the technological interventions implemented by ERCS have an influential impact on various aspects of HSCP. For instance, the use of GPS for tracking aid deliveries received a mean score of 3.13(SD 0.0.93), placing it within the Moderately Influential range. Similarly, the use of ICT for coordinating stakeholders and for inventory management accuracy received mean scores of 3.28 (SD 0.0.86)and 3.31(SD 0.83), respectively, also falling within the Moderately Influential range.

According to Xu *et al.* (2021), integrating technologies enhances supply chain performance. It aslo adds significant value to HSCs (Abidi *et al.*, 2015), and improves HSCP (Haavisto & Kovacs, 2015). In this study, on average, the indicators reflecting technological advancements in ERCS's HSCP have a mean score of 3.24. This suggests a generally an influential view of technological advancements among the staff, although to a moderate extent, with ICT being particularly appreciated for its role in stakeholder coordination and inventory management. Low utilization of performance indicators indicates room for operational efficiency improvements via technology (Santarelli *et al.*, 2015).

The standard deviations, ranging from 0.83 to 0.93, indicate relatively consistent responses among the respondents regarding these technological practices.

4.3.2. Standardization

Table 7 presents the impact of standardization on HSCP, focusing on indicators such as standardized packaging for safe handling of relief items and transportation, standardized quality control measures, and standardized documentation to reduce errors.

Table 7: Impact of Standardization on HSCP

Standardization Indicators	SD	D	N	A	SA	Mean	Stdv
There is standardized packaging to safe handling of relief items & transportation at ERCS	2	8	35	47	2	3.41	0.768
There are standardized quality control measures to check the quality and safety of aid items	2	5	30	54	3	3.54	0.743
There is standardized documentation to reduce errors at ERCS.	2	5	28	56	3	3.56	0.741
				Mean Avarage		**3.5**	

Source: Self-conducted survey, 2024

Standardizing data and distribution are important for HSCP (Xu *et al.*, 2021). Standardization enhances HSCP by implementing uniform guidelines and procedures (Rahman *et al.*, 2022). It ensures strategic use of limited resources and contributes positively to logistics performance (Santarelli *et al.*, 2015).

When interpreting the mean scores of standardization in this study based on the Mean Range Interpretation from Table 5, the findings indicate that standardization practices implemented by ERCS have a significant impact on various aspects of HSCP. For example, standardized packaging for safe handling of relief items and transportation received a mean score of 3.41(SD 0.768), falling within the Influential range. Similarly, standardized quality control measures and standardized documentation to reduce errors received mean scores of 3.54(SD 0.743) and 3.56(SD 0.741), respectively, also falling within the Influential range.

These findings suggest that standardization initiatives, including standardized packaging, quality control measures, and documentation processes, significantly contribute to enhancing the efficiency, accuracy, and safety of humanitarian aid delivery processes within ERCS. This

underscores the importance of adopting standardized practices to improve overall supply chain performance and ensure the effective and timely delivery of aid to those in need.

4.3.3. Collaboration

Table 8 presents the impact of collaboration on HSCP, focusing on indicators such as long-term collaboration among humanitarian organizations, local and international partnerships for aid distribution improvement, and fast information sharing practices among stakeholders to enhance emergency response.

Table 8: Impact of Collaboration on HSCP

Collaboration Indicators	SD	D	N	A	SA	Mean	Stdv
ERCS has long-term collaboration among humanitarian organizations to enhance humanitarian aid delivery.	5	0	9	60	20	3.96	0.891
ERCS has local and international partnerships to improve aid distribution.	4	1	4	66	19	4.01	0.823
ERCS has fast information sharing practices among stakeholders to improve emergency response.	2	2	17	57	16	3.88	0.788
	Mean Avarage					**3.95**	

Source: Self-conducted survey, 2024

Collaboration is necessary for effective coordination and trust among humanitarian actors (Dubey *et al.*, 2017). It is needed for achieving joint objectives and efficient crisis response, and is facilitated by digital technologies within supply chains to enhance coordination, integration, and resource mobilization (Dubey, 2022).

In this study, when interpreting the mean scores of collaboration based on the Mean Range Interpretation from Table 5, the findings indicate that collaboration efforts within ERCS significantly impact various aspects of HSCP. For instance, long-term collaboration among humanitarian organizations received a mean score of 3.96(SD 0.89), falling within the Influential range. Similarly, local and international partnerships for aid distribution improvement received a mean score of 4.01(SD 0.823), also falling within the Influential range. In addition, fast

information sharing practices among stakeholders to enhance emergency response received a mean score of 3.88(SD 0.788), also falling within the Influential range.

These findings suggest that collaboration initiatives, including long-term partnerships and fast information sharing practices, play a crucial role in improving the efficiency, coordination, and responsiveness of HSC operations within ERCS. This underscores the importance of fostering collaborative relationships with various stakeholders to ensure the effective and timely delivery of aid to affected populations. This indicates a strong agreement on the importance of efficient information sharing practices in enhancing emergency response.Chari *et al.* (2021) highlight the positive impact of supply chain collaboration on aid delivery performance in humanitarian operations.

4.3.4. Leadership

Table 9 presents the impact of leadership on HSCP, focusing on indicators such as visionary leadership driving innovation in supply chain management, transformational leadership supporting adaptability during crises, and inspirational motivation leadership commitment within ERCS's supply chain.

Table 9: Impact of Leadership on HSCP

Leadership Indicators	SD	D	N	A	SA	Mean	Stdv
Visionary leadership of ERCS drives innovation in its supply chain management.	3	7	31	49	4	3.47	0.826
Transformational leadership of ERCS supports adaptability (Flexibility) of the relief service during crises.	5	3	25	58	3	3.54	0.838
There is inspirational motivation leadership commitment in ERCS's supply chain	4	4	23	58	5	3.6	0.834
	Mean Avarage					**3.54**	

Source: Self-conducted survey, 2024

Effective leadership is important for shaping HSCP (Fiorini *et al.*, 2021). It is a critical success factor in humanitarian logistics (Dubey *et al.*, 2015). Its support significantly drives the implementation of HSC management) for effective crisis response and aid delivery (Agarwal *et al.*, 2020). In this study, when the mean scores of leadership is interpreted based on the Mean Range Interpretation from Table 5, the findings indicate that leadership qualities within ERCS

significantly influence various aspects of HSCP. For example, visionary leadership driving innovation received a mean score of 3.47(SD 0.826), falling within the Moderately Influential range. Similarly, transformational leadership supporting adaptability during crises received a mean score of 3.54(SD 0.838), also falling within the Moderately Influential range. Also, inspirational motivation leadership commitment within ERCS's supply chain received a mean score of 3.6(SD 0.834), also falling within the Influential range.

These findings suggest that different leadership styles, including visionary, transformational, and inspirational motivation leadership, play essential roles in driving innovation, adaptability, and commitment within ERCS's HSC. This underscores the significance of effective leadership in navigating complex challenges and ensuring the successful delivery of aid to communities in need.

On average, the indicators reflecting leadership practices in ERCS's HSCP have a mean score of 3.54. This average suggests a generally influential view of leadership within the ERCS, with particular appreciation for transformational and inspirational motivation leadership styles. The standard deviations, ranging from 0.826 to 0.838, indicate a relatively consistent agreement among employees regarding these leadership practices.

4.4. Humanitarian supply chain performance (HSCP):Descriptive analysis

As per Chari *et al.* (2020), assessing the performance of humanitarian supply chains is crucial for enhancing the efficacy and efficiency of humanitarian endeavors. Performance measurement is needed in HSCs (D'Haene *et al.*, 2015). Identifying critical success factors and performance indicators is essential for managing and evaluating supply chain performance (Santarelli *et al.*, 2015; Abidi *et al.*, 2014). In this study, the results of four humanitarian supply supply performance metrics were analysed.

4.4.1. Reliability

Table 10 evaluates reliability as a factor in measuring HSCP, focusing on metrics such as timely development of operational plans, on-time delivery of aid items, timely follow-up of procurement processes, prioritization of on-time demand fulfillment in logistics operations, and the utilization of reverse flow processes for returning unused and unwanted items.

Table 10: Reliability as a factor in measuring HSCP

Reliability Metrics	SD	D	N	A	SA	Mean	Stdv
ERCS consistently and timely develops plans to operate the humanitarian supply chain	1	8	24	57	4	3.59	0.754
ERCS manages delivering aid items for the humanitarian supply chain on time.	4	7	27	55	1	3.45	0.825
ERCS timely follows up the procurement processes of relief items	3	4	24	57	6	3.63	0.803
ERCS's logistics operations prioritize on-time demand fulfillment.	2	7	25	51	9	3.62	0.844
Unused and unwanted items are returned through the reverse flow process.	1	6	30	47	10	3.63	0.803
	Mean Avarage					**3.584**	

Source: Self-conducted survey, 2024

When interpreting the mean scores based on the Mean Range Interpretation from Table 5, the findings suggest that reliability metrics within ERCS significantly contribute to enhancing various aspects of HSCP. For instance, the timely development of operational plans received a mean score of 3.59(SD 0.754), falling within the Influential range. Similarly, the timely follow-up of procurement processes and the utilization of reverse flow processes for returning unused and unwanted items both received mean scores of 3.63 (SD 0.803), also falling within the Influential range. Also, logistics operations prioritizing on-time demand fulfillment received a mean score of 3.62(SD 0.803), also falling within the Influential range.

These findings underscore the importance of reliability in ensuring the effective and efficient functioning of HSCs. Timely operational planning, procurement processes, and logistics operations are crucial for meeting the demands of affected populations promptly and efficiently. Moreover, the utilization of reverse flow processes helps mitigate waste and optimize resource utilization within the supply chain, further enhancing its reliability and performance.

4.4.2. Responsiveness

Table 11 illustrates responsiveness as a factor in measuring HSCP, assessing metrics such as timely and quick emergency planning, timely procurement practices, readiness of relief items, timely distribution of relief items, and the prompt return of defective and expired relief items to ERCS offices.

Table 11: Responsiveness as a factor in measuring HSCP

Responsiveness Metrics	SD	D	N	A	SA	Mean	Stdv
ERCS plans timely and quickly to be ready for emergencies	2	5	26	60	1	3.56	0.712
Procurement practices of ERCS is timely.	2	7	29	55	1	3.49	0.744
ERCS makes ready relief items on timely manner	3	5	27	57	2	3.53	0.772
ERCS distributes relief items on timely manner	2	6	30	54	2	3.51	0.744
Defective and expired relief items are retuned back to the ERCS office on time	2	3	25	58	6	3.67	0.739
	Mean Avarage					**3.552**	

Source: Self-conducted survey, 2024

Whele interpreting the mean scores based on the Mean Range Interpretation from Table 5, the findings indicate that responsiveness metrics within ERCS significantly influence various aspects of HSCP. For example, timely and quick emergency planning received a mean score of 3.56 (SD 0.712), falling within the Influential range. Similarly, the timely procurement practices and readiness of relief items both received mean scores of 3.49 (SD 0.744)and 3.53(SD 0.772), respectively, also falling within the Influential range. In addition, the timely distribution of relief items and the prompt return of defective and expired relief items received mean scores of 3.51 (SD 0.744) and 3.67(SD 0.739), respectively, also falling within the Influential range.

These findings highlight the importance of responsiveness in effectively addressing humanitarian crises and ensuring the timely delivery of aid to affected populations. Timely emergency planning, procurement practices, readiness, distribution, and the management of defective items are essential for enhancing the efficiency and effectiveness of HSCs, ultimately contributing to better outcomes for those in need.

4.4.3 Flexibility (Agility)

Table 12 presents flexibility (agility) as a factor in measuring HSCP, evaluating metrics such as flexibility in preparing supply chain plans, seeking alternative suppliers during crises, flexible stocking schedules during emergencies, adapting logistics operations to new delivery routes and transportation modes, and managing the return of defective and expired relief items through reverse logistics processes.

Table 12: Flexibility (Agility) as a factor in measuring HSCP

Flexibility Metrics	SD	D	N	A	SA	Mean	Stdv
There is flexibility at ERCS in preparing supply chain plans.	2	2	27	55	8	3.69	0.748
ERCS's procurement activities seek alternative suppliers in flexible approach during crises.	1	5	25	51	12	3.72	0.765
ERCS's stocking schedules is flexible during emergencies.	2	2	22	64	4	3.70	0.685
ERCS's logistics operations adapt to new delivery routes and transportation modes when needed.	3	3	24	60	4	3.63	0.762
ERCS's reverse logistics processes manage the return of defective and expired relief items.	2	3	25	54	10	3.71	0.785
	Mean Avarage					**3.69**	

Source: Self-conducted survey, 2024

When interpreting the mean scores based on the Mean Range Interpretation from Table 5, the findings indicate that flexibility metrics within ERCS significantly influence various aspects of HSCP. For example, flexibility in preparing supply chain plans received a mean score of 3.69(SD 0.748), falling within the Influential range. Similarly, seeking alternative suppliers during crises and flexible stocking schedules during emergencies both received mean scores of 3.72(SD 0.765) and 3.70(SD 0.685), respectively, also falling within the Influential range. Additionally, adapting logistics operations to new delivery routes and transportation modes and managing the return of defective and expired relief items through reverse logistics processes

received mean scores of 3.63 (SD 0.762) and 3.71(SD 0.785), respectively, also falling within the Moderately Influential range.

These findings underscore the importance of flexibility (agility) in effectively responding to humanitarian crises and ensuring the timely and efficient delivery of aid to affected populations. Flexibility in supply chain planning, procurement, stocking, logistics operations, and reverse logistics processes enables ERCS to adapt to changing circumstances and optimize their response efforts, ultimately contributing to better outcomes for those in need.

4.4.4. Supply Chain Cost

Table 13 examines supply chain cost as a factor in measuring HSCP, evaluating metrics such as cost-effective supply chain planning, procurement activities, minimizing costs in producing relief items, economical delivery operations, and cost-effective management of reverse SCOs.

Table 13: Supply Chain Cost as a factor in measuring HSCP

Cost Metrics	SD	D	N	A	SA	Mean	Stdv
ERCS prepares supply chain planning in a cost-effective way	4	1	18	63	8	3.74	0.802
ERCS has cost-effective procurement activities	2	1	22	59	10	3.79	0.731
ERCS minimizes the cost to make relief items by saving materials and labor cost.	0	2	19	66	7	3.83	0.58
ERCS's delivery operations are economical through efficient planning and resource utilization.	3	2	10	70	9	3.85	0.747
ERCS manages reverse supply chain operations in cost effective manner.	0	4	20	62	8	3.79	0.654
					Mean Avarage	**3.80**	

Source: Self-conducted survey, 2024

Optimizing supply chains is vital for successful humanitarian activities, requiring consistent improvements in efficiency and cost-effectiveness (Nsereko & Nanzekho, 2022). When the mean scores of supply chain cost is interpreted based on the Mean Range Interpretation from Table 5, the findings indicate that cost metrics within ERCS significantly influence various aspects of

HSCP. For instance, cost-effective supply chain planning received a mean score of 3.74 (SD 0.80.), falling within the Influential range. Similarly, cost-effective procurement activities and minimizing costs in producing relief items both received mean scores of 3.79(SD 0.731)and 3.83(SD 0.58), respectively, also falling within the Influential range. Additionally, economical delivery operations and cost-effective management of reverse SCOs received mean scores of 3.85 (SD 0.747) and 3.79 (SD 0.654), respectively, also falling within the Influential range.

These findings highlight the importance of cost-effectiveness in HSCM, as efficient planning, procurement, production, delivery, and reverse logistics operations contribute to maximizing the impact of aid efforts while optimizing resource utilization. By minimizing costs and maximizing efficiency throughout the supply chain, ERCS can stretch its resources further and reach more people in need, ultimately improving the effectiveness and sustainability of humanitarian aid delivery.

4.5. Analysis of key factors influencing supply chain performance metrics

Multicollinearity in regression analysis

Multicollinearity in regression analysis leads to challenges in interpreting the effects of individual variables on the response variable (Graham, 2003), causing unstable estimates, inaccurate variances, and impacting the validity of statistical inferences (Vatcheva *et al.*, 2016). Table 14 presents the collinearity statistics for various independent variables - Technological Advancements, Standardization, Collaboration, and Leadership -against four dependent variables: Reliability, Responsiveness, Flexibility, and Supply Chain Cost.

Multicollinearity occurs in multiple linear regression when two or more independent variables are highly correlated with each other. This high correlation makes it difficult to determine the individual effect of each predictor on the dependent variable. Variance Inflation Factor (VIF) and tolerance values are commonly employed diagnostic measures for this purpose (Senaviratna & Cooray, 2019). Tolerance values close to 1 indicate lower collinearity, while values closer to 0 indicate higher collinearity. VIF values greater than 10 suggest high collinearity among the predictors, while values around 1 indicate low collinearity.

The consistent values across all four dependent variables in this study (Reliability, Responsiveness, Flexibility, and Supply Chain Cost) indicate a stable relationship between the

independent and dependent variables, indicating no significant multicollinearity concerns among the independent variables in relation to each dependent variable. This is because all VIF values are below 10, and all tolerance values are above 0.1 (Table 14).

Table 14. Multi collinearity test result of independent variable

Dependent Variable	Independent variable	Collinearity Statistics	
		Tolerance	**VIF**
Reliability	Technological Advancements	.724	1.382
	Standardization	.552	1.810
	Collaboration	.650	1.538
	Leadership	.561	1.782
Responsiveness	Technological Advancements	.724	1.382
	Standardization	.552	1.810
	Collaboration	.650	1.538
	Leadership	.561	1.782
Flexibility	Technological Advancements	.724	1.382
	Standardization	.552	1.810
	Collaboration	.650	1.538
	Leadership	.561	1.782
Supply Chain Cost	Technological Advancements	.724	1.382
	Standardization	.552	1.810
	Collaboration	.650	1.538
	Leadership	.561	1.782

Source: Self-conducted survey, 2024

Test of autocorrelations

As a regression assumption test, a Durbin-Watson test was also conducted to determine if there is a relationship between the independent variables and the residuals. The results showed that all Durbin-Watson values are within the range of $1.5 < DW < 2.5$ (See the Table below). These results confirm that there are no significant relationships between the residuals and the independent variables, supporting the validity of the regression models used.

Durbin-Watson Test Results

Independent variables	Dependent variables	Durbin-Watson
Technological advancement, Standardization, Collaboration and Leadership	Reliability	1.960
	Responsiveness	1.661
	Flexibility	1.624
	Supply Chain Cost	1.852
	HSCP	1.632

Furthermore, before conducting the analysis, all variables were converted into continuous data using composite means. As a result of this conversion, the relationships between the independent variables (Technological Advancement, Standardization, Collaboration, and Leadership) and the dependent variables (Reliability, Responsiveness, Flexibility, Supply Chain Cost, and HSCP) are assumed to be linear. A linear relationship means that any change in an independent variable leads to a proportional change in the corresponding dependent variable. For example, an increase in Technological Advancement should result in a proportional increase or decrease in Reliability, depending on the nature of their relationship.

4.6. Inferential statistics for metrics measuring HSCP at ERCS

Santarelli *et al.* (2015) suggest that analyzing real results and implementing performance measurement systems can lead to identifying best practices for improving the efficiency and effectiveness of HSCs. In this study, multiple linear regression analyses were conducted to examine the effects of *Technological Advancements*, *Standardization*, *Collaboration*, and *Leadership* on four dependent metric variables, i.e., *Reliability*, *Responsiveness*, *Flexibility*, and *Supply Chain Cost*. The results provide an understandings of the influence of these predictor metrics on each outcome.

4.6.1 Reliability as measures of HSCP

A multiple linear regression analysis was performed to investigate the impact of Technological Advancements, Standardization, Collaboration, and Leadership on Reliability. The model summary, regression equation, ANOVA results, regression coefficients, interpretation of the coefficients, and model fit and diagnostics are presented below.

Model Summary

The model was statistically significant, ($F(4, 89) = 12.332$, $p < .001$), and explained approximately 35.7% of the variance in reliability, ($R^2 = .357$) (adjusted ($R^2 = .328$)). The Durbin-Watson statistic was 1.960, indicating no significant autocorrelation in the residuals.

ANOVA Results

The analysis of variance (ANOVA) results indicate that the overall model was significant.

Table 15: Analysis of variance (ANOVA) results for reliability

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	14.038	4	3.510	12.332	.000
Residual	25.327	89	.285		
Total	39.366	93			

Source: Self-conducted survey, 2024

Regression Coefficients

The regression coefficients, their standard errors, t-values, and p-values are presented in Table 16.

Table 16. Regression coefficient analysis results for reliability

Variable	B	SE(B)	β	t	p	Tolerance	VIF
(Constant)	1.477	.363	-	4.074	.000	-	-
Technological Advancements	-0.101	.095	-.107	-1.067	.289	.724	1.382
Standardization	0.322	.113	.327	2.857	.005	.552	1.810
Collaboration	0.041	.092	.047	.448	.656	.650	1.538
Leadership	0.322	.102	.360	3.174	.002	.561	1.782

Dependent variable:Reliability

Source: Self-conducted survey, 2024

Regression Equation

The prediction equation for the model is:

$$Y = B_0 + B_1 X_1 + B_2 X_2 + \ldots + B_z X_z + 0.05\varepsilon$$

Where

z is the number of independent variables,

Y is the dependent variable,

Xs are independent variables and

The Bs are the coefficients

Accordingly, the regression equation for the model is:

Reliability = 1.477 + (0.322×Standardization) + (0.322×Leadership) + 0.05ε

Interpretation of the Coefficients

In the model, the intercept was 1.477, denoting the predicted reliability when all predictors are zero, and it was statistically significant ($p < .001$). Concerning standardization, the coefficient was 0.322, also statistically significant ($p = .005$), indicating a positive impact on reliability. Specifically, each unit increase in standardization was associated with a 0.322 increase in reliability. Similarly, leadership exhibited a coefficient of 0.322, statistically significant ($p = .002$), signifying a positive influence on reliability. For leadership, each unit increase was associated with a 0.322 increase in reliability.

The results of the analysis indicated that that both standardization and leadership significantly enhance HSCP with respect to reliability. This shows that that standardization and strong leadership have roles to improve the reliability of SCOs.

Model Fit and Diagnostics

The overall model fit was assessed using R^2, adjusted R^2, and the F-test. The R^2 value of .357 indicates that 35.7% of the variance in reliability is explained by the model. The F-test result, $F(4,89) = 12.332$, $p<.001$, confirms that the model is statistically significant.

4.6.2 Responsiveness as measures of HSCP

A multiple linear regression analysis was performed to investigate the impact of Technological Advancements, Standardization, Collaboration, and Leadership on responsiveness. The model

summary, regression equation, ANOVA results, regression coefficients, interpretation of the coefficients, and model fit and diagnostics are presented below.

Model Summary

The model was statistically significant, $F(4,89) = 22.118$, $p<.001$, and explained approximately 49.9% of the variance in responsiveness, $R^2 = .499$ (adjusted $R^2 = .476$). The Durbin-Watson statistic was 1.661, indicating no significant autocorrelation in the residuals.

ANOVA results

The analysis of variance (ANOVA) results (Table 17) indicate that the overall model was significant.

Table 17: Analysis of variance (ANOVA) results for Responsiveness

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	16.687	4	4.172	22.118	.000
Residual	16.787	89	.189		
Total	33.474	93			

Source: Self-conducted survey, 2024

Regression Coefficients

The regression coefficients, their standard errors, t-values, and p-values are presented in Table 18.

Table 18. Regression coefficient analysis results for Responsiveness

Variable	B	SE(B)	β	t	p	Tolerance	VIF
(Constant)	1.025	.295	-	3.471	.001	-	-
Technological Advancements	0.028	.077	.032	0.359	.720	.724	1.382
Standardization	0.458	.092	.504	4.990	.000	.552	1.810
Collaboration	0.068	.075	.085	0.912	.364	.650	1.538
Leadership	0.159	.083	.193	1.928	.057	.561	1.782

Dependent variable: Responsiveness

Source: Self-conducted survey, 2024

Regression Equation

The regression equation for the model is:

Responsiveness = 1.025 + 0.458×Standardization + 0.05ε

Interpretation of the Coefficients

The intercept in the model was 1.025, suggesting the predicted responsiveness when all predictors are zero, and it was statistically significant (p = .001). Regarding standardization, the coefficient was 0.458, also statistically significant (p < .001), implying a positive influence on responsiveness. Specifically, each unit increase in standardization was associated with a 0.458 increase in responsiveness. The results of the analysis indicated that standardization has a strong positive impact on responsiveness.

Model Fit and Diagnostics

The overall model fit was assessed using R^2, adjusted R^2, and the F-test. The R^2 value of .499 indicates that 49.9% of the variance in responsiveness is explained by the model. The F-test result, F(4,89) = 22.118, p<.001, confirms that the model is statistically significant.

4.6.3. Flexibility as measures of HSCP

A multiple linear regression analysis was performed to investigate the impact of Technological Advancements, Standardization, Collaboration, and Leadership on flexibility. The model summary, regression equation, ANOVA results, regression coefficients, interpretation of the coefficients, and model fit and diagnostics are presented below.

Model Summary

The model was statistically significant, F(4,89) = 15.057, p<.001, and explained approximately 40.4% of the variance in flexibility, R^2 = .404 (adjusted R^2 = .377). The Durbin-Watson statistic was 1.625, indicating no significant autocorrelation in the residuals.

ANOVA result

The analysis of variance (ANOVA) results (Table 19) indicate that the overall model was significant.

Table 19: Analysis of variance (ANOVA) results for flexibility

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	13.131	4	3.283	15.057	.000
Residual	19.403	89	.218		
Total	32.533	93			

Source: Self-conducted survey, 2024

Regression Equation

The regression equation for the model is:

Flexibility = 1.669 + (0.241×Standardization) ++ (0.370×Leadership) + 0.05ε

Regression Coefficients

The regression coefficients, their standard errors, t-values, and p-values are presented in Table 20.

Table 20. Regression coefficient analysis results for Flexibility

Variable	B	SE(B)	β	t	p	Tolerance	VIF
(Constant)	1.669	.317	-	5.259	.000	-	-
Technological Advancements	-0.064	.083	-.075	-0.776	.440	.724	1.382
Standardization	0.241	.099	.269	2.446	.016	.552	1.810
Collaboration	0.019	.081	.024	0.239	.812	.650	1.538
Leadership	0.370	.089	.455	4.166	.000	.561	1.782

Dependent variable: Flexibility

Source: Self-conducted survey, 2024

Interpretation of the Coefficients

In the model, the intercept was 1.669, indicating the predicted flexibility when all predictors are zero, and it was statistically significant ($p < .001$). Regarding standardization, the coefficient was 0.241, also statistically significant ($p = .016$), suggesting a positive impact on flexibility. Specifically, each unit increase in standardization was associated with a 0.241 increase in flexibility. Similarly, leadership exhibited a coefficient of 0.370, statistically significant ($p <$

.001), indicating a positive influence on flexibility. For leadership, each unit increase was associated with a 0.370 increase in flexibility.

The results of the analysis indicated that standardization and leadership significantly contribute to flexibility in HSCP, indicating that standardized processes and strong leadership improve the flexibility of supply chains.

Model Fit and Diagnostics

The overall model fit was assessed using R^2, adjusted R^2, and the F-test. The R^2 value of .404 indicates that 40.4% of the variance in flexibility is explained by the model. The F-test result, $F(4,89)=15.057, p<.001F(4, 89) = 15.057, p < .001F(4,89)=15.057, p<.001$, confirms that the model is statistically significant.

4.6.4. Leadership as measures of HSCP

A multiple linear regression analysis was performed to investigate the impact of Technological Advancements, Standardization, Collaboration, and Leadership on **Supply Chain Cost**. The model summary, regression equation, ANOVA results, regression coefficients, interpretation of the coefficients, and model fit and diagnostics are presented below.

Model Summary

The model was statistically significant, $F(4,89) =16.839, p<.001$, and explained approximately 43.1% of the variance in supply chain cost, $R^2 =.431$ (adjusted $R^2 =.405$). The Durbin-Watson statistic was 1.853, indicating no significant autocorrelation in the residuals.

ANOVA Results

The analysis of variance (ANOVA) results (Table 21) indicate that the overall model was significant.

Table 21: Analysis of variance (ANOVA) results for Supply Chain Cost

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	11.235	4	2.809	16.839	.000
Residual	14.845	89	.167		
Total	26.080	93			

Source: Self-conducted survey, 2024

Regression Coefficients

The regression coefficients, their standard errors, t-values, and p-values are presented in Table 22.

Table 22: Regression coefficient analysis results for Supply Chain Cost

Variable	B	SE(B)	β	t	p	Tolerance	VIF
(Constant)	1.656	.278	-	5.963	.000	-	-
Technological Advancements	0.027	.073	.035	0.374	.709	.724	1.382
Standardization	0.262	.086	.327	3.042	.003	.552	1.810
Collaboration	0.112	.071	.157	1.584	.117	.650	1.538
Leadership	0.197	.078	.270	2.529	.013	.561	1.782

Dependent variable:Supply Chain Cost

Source: Self-conducted survey, 2024

Regression Equation

The regression equation for the model is:

Supply Chain Cost = 1.656 + 0.262×Standardization + 0.197×Leadership + 0.05ε

Interpretation of the Coefficients

In the model, the intercept was 1.656, signifying the predicted supply chain cost when all predictors are zero, and it was statistically significant ($p < .001$). Concerning standardization, the coefficient was 0.262, also statistically significant ($p = .003$), suggesting a positive impact on supply chain cost. Specifically, each unit increase in standardization was associated with a 0.262 increase in supply chain cost. Similarly, leadership exhibited a coefficient of 0.197, statistically significant ($p = .013$), indicating a positive influence on supply chain cost. For leadership, each unit increase was associated with a 0.197 increase in supply chain cost.

The results of the analysis indicated that both standardization and leadership significantly increase supply chain costs, suggesting that while these factors improve other aspects of supply chain performance, they also contribute to higher operational costs.

Model Fit and Diagnostics

The overall model fit was assessed using R^2, adjusted R^2, and the F-test. The R^2 value of .431 indicates that 43.1% of the variance in supply chain cost is explained by the model. The F-test result, $F(4,89)=16.839, p<.001$, confirms that the model is statistically significant.

4.6.5. Regression summary result

The four supply chain performance metrics (*Reliability, Responsiveness, Flexibility, and Suply Chain Cost*) were computed as one dependent variable, i.e., HSCP and were regressed against the four independent variable (*Leadership, Technological Advancements, Collaboration, and Standardization*) to test the hypothesis.

Model summary

The model summary (Table 23) provides the correlation coefficient (R) of 0.731, indicating a strong positive relationship between the independent variables (Leadership, Technological Advancements, Collaboration, and Standardization) and the dependent variable (HSCP). The (R2) value is 0.535, suggesting that 53.5% of the variability in HSCP can be explained by these independent variables. The Durbin-Watson statistic of 1.632 suggests no significant autocorrelation in the residuals.

Table 23: Model summary table for HSCP

Model Summary[b]					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.731[a]	.535	.514	.36078	1.632
a. Predictors: (Constant), Leadership, Technological Advancements, Collaboration, Standardization					
b. Dependent Variable: HSCP					

Source: Self-conducted survey, 2024

ANOVA Results

In the ANOVA table, the regression sum of squares (SSR) is 13.312, indicating the amount of variation explained by the model. The residual sum of squares (SSE) is 11.584, representing the variation not explained by the model, while the total sum of squares (SST) is 24.896, which is the total variation in HSCP. The model has 4 predictors, giving it 4 degrees of freedom, and 89

residual degrees of freedom. The mean square values for regression and residuals are 3.328 and 0.130, respectively. The F-statistic is 25.569, a high value that indicates the model is a good fit for the data, with a significance (p-value) of 0.000, showing that the overall model is statistically significant at the 5% level (Table 24).

Table 24: Analysis of variance (ANOVA) results for HSCP

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.312	4	3.328	25.569	.000[b]
	Residual	11.584	89	.130		
	Total	24.896	93			
a. Dependent Variable: HSCP b. Predictors: (Constant), Leadership, Technological Advancements, Collaboration, Standardization						

Source: Self-conducted survey, 2024

Regression coefficients

The constant (intercept) in the coefficients table is 1.457, meaning the expected value of HSCP when all predictors are zero. The regression result (Table 25) indicates that Standardization and Leadership have significant positive impacts on HSCP.

Table 25: Regression coefficient analysis results for HSCP

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.457	.245		5.940	.000
	Technological Advancements	-.028	.064	-.037	-.432	.667
	Standardization	.321	.076	.410	4.210	.000
	Collaboration	.060	.062	.087	.965	.337
	Leadership	.262	.069	.368	3.817	.000
a. Dependent Variable: HSCP						

Source: Self-conducted survey, 2024

Regression Equation

Th regression equation for the model is:

$$HSCP = 1.457 + 0.321Standardization + 0.262Leadership + 0.05\varepsilon$$

The regression model explains the variability in HSCP (53.5%). In the model, the intercept was 1.457, signifying the HSCP when all predictors are zero, and it was statistically significant ($p < .001$). Concerning standardization, the coefficient was 0.321, also statistically significant ($p = .003$), suggesting a positive impact on HSCP. Specifically, each unit increase in standardization was associated with a 0.321 increase in HSCP. Similarly, leadership exhibited a coefficient of 0.262, statistically significant ($p < .001$), indicating a positive influence on HSCP. For leadership, each unit increase was associated with a 0.0.262 increase in HSCP. However, Technological Advancements and Collaboration do not show significant effects. The model's overall significance, with an F-statistic of 25.569 and a p-value of 0.000, suggests that it is a strong fit for the data. Despite this, the individual significance of predictors varies, highlighting areas where specific factors play more crucial roles than others in influencing HSCP.

4.6.6. Regression analysis results relative to the study hypothesis

Regression analysis is a statistical tool widely used in various fields; it involves fitting a mathematical model to data to understand the relationship between variables. It provides insights for policy development (Schaik *et al.*, 2019). Moreover, it is used to extract generalizable results (Hay & Knechel, 2016). In this study, multiple regression analysis were tested for the four supply chain performance metrics (*Reliability*, *Responsiveness*, *Flexibility*, *and Leadership*), computed as one dependent variable, i.e., HSCP and were regressed against the four independent variable (*Leadership, Technological Advancements, Collaboration, and Standardization*) to test the hypothesis. The hypothesis test result is indicated in Table 26.

Table 26. Hypothesis testing result and desion

Hypothesis	Unstandardized Coefficients B	Standardized Coefficients Beta (β)	P-value	Decision
$H1_a$: Technological advancement has positive and significant effect on HSCP	-.028	-.037	.667	*$H1_a$:* Rejected *$H0_a$:* Accepted
$H1_b$: Standardization has a positive and significant effect on the HSCP	.321	.410	<0.01	*$H1_b$:* Accepted *$H0_b$:* Rejected
$H1_c$: Collaboration positively and significantly impacts the performance of HSC.	.060	.087	.337	*$H1_c$:* Rejected *$H0_c$:* Accepted
$H1_d$: The effectiveness of leadership significantly influences the performance of HSC	.262	.368	<0.01	*$H1_d$:* Accepted *$H0_d$:* Rejected

Source: Self-conducted survey, 2024

The regression analysis results indicate that out of the four hypotheses tested, only two were accepted, i.e., those related to Standardization and Leadership having a significant positive impact on HSCP (Humanitarian Supply Chain Performance). However, the hypotheses regarding Technological Advancement and Collaboration were rejected as they did not show significant effects in the study (Table 26). These rejections could be due to various reasons. For example, organizational resistance to adopting new technology may affect its effectiveness. Employees and management may also be resistant to change, leading to the underutilization of technological tools. It is not just the adoption of advanced technologies that guarantees improved performance, but how well the technology is integrated into existing processes and implemented (Arlbjørn and Paulraj, 2013). Besides, although technology has the potential to improve supply chain performance, its effectiveness is influenced by the organization's culture and readiness to embrace change (Gunasekaran *et al*., 2017).

Regarding collaboration, its effectiveness requires high levels of trust and communication among supply chain partners to produce significant improvements (Barratt, 2004). The level of trust and quality of communication among partners is important for achieving better performance. However, the benefits of collaboration might be harder to measure and attribute directly to supply chain performance improvements (Barratt, 2004).

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

In this chapter, the key findings of the study were summarized, their implications were discussed, and the conclusion and recommendations for future research or practical applications were suggested.

5.1. Summary of Findings

This study offers valuable information about the factors influencing supply chain performance within the ERCS. It examined the impact of technological advancements, standardization, collaboration, and leadership on four key metrics: reliability, responsiveness, flexibility, and supply chain cost. Regression analyses revealed varying degrees of significance among these factors across different metrics. Particularly, standardization emerged as a consistent positive influencer across several metrics, including reliability, responsiveness, and flexibility. Leadership also exhibited a significant positive impact on reliability, responsiveness, flexibility, and supply chain cost, underscoring its critical role in driving overall HSC performance.

In contrast, the effects of technological advancements and collaboration were less pronounced. While technological advancements showed no significant impact on reliability and responsiveness, they marginally influenced flexibility and supply chain cost. Collaboration, similarly, demonstrated mixed results, with no significant effect observed on reliability and responsiveness. These findings suggest a multifaceted relationship between these factors and supply chain performance within ERCS, highlighting the need for tailored strategies to impact their potential effectively.

The interpretation of regression coefficients provides detailed insights into the significance and directionality of each factor's influence on supply chain metrics. The analysis revealed that while standardization consistently enhanced reliability, responsiveness, and flexibility, leadership emerged as a crucial determinant across all metrics. Its positive impact underscores the pivotal role of strong leadership in driving efficiency and effectiveness within SCOs. Moreover, collinearity statistics assured the stability of relationships between independent and dependent variables, affirming the strength of the analytical approach employed.

In general, the study’s findings emphasize the importance of standardized processes and effective leadership in optimizing supply chain performance within ERCS. By prioritizing these

factors, organizations can enhance reliability, responsiveness, flexibility, and cost-effectiveness, ultimately advancing their humanitarian efforts and ensuring the efficient delivery of aid to those in need. The findings from this study provide a valuable foundation for strategic decision-making and continuous improvement initiatives aimed at strengthening SCOs within the ERCS.

5.2. Conclusion

The study underscores the importance of Standardization and Leadership in enhancing HSCP at the ERCS. The significant positive impacts of these factors indicate that focusing on developing and enforcing standardized procedures and strengthening leadership can substantially improve the efficiency and responsiveness of humanitarian operations. Conversely, the study found that Technological Advancements and Collaboration do not significantly influence HSCP in this context. Therefore, while technology and partnerships remain important, their current implementation might not be as effective as anticipated at ERCS. Future efforts should prioritize leadership development and standardization to achieve better performance in HSCs at ERCS.

5.3. Recommendations

Based on the findings, the study suggests the following recommendations to o enhance the HSCP efficiency in aid delivery:

i. ERCS should implement and rigorously enforce standard operating procedures across all SCOs to improve efficiency.
ii. Academia should conduct in-depth studies on how specific aspects of standardization and leadership directly influence HSCP and identify best practices that can be generalized to other similar organizations.
iii. Policymakers should formulate policies that encourage and facilitate the standardization of HSC processes within ERCS and other aid organizations in Ethiopia.
iv. Practitioners should embrace and effectively use advanced technology tools (e.g., SCM software and ICT technology) to monitor, manage, and optimize SCOs towards ensuring timely and cost-effective aid delivery.

5.4. Suggestions for Further Research

Based on the findings and limitations identified in the study, the following points should be considered in future researches to explore and address the remaining gaps:

1. Conducting longitudinal studies is needed to track the impact of implemented interventions over an extended period. This would provide perceptions about the sustainability and long-term effectiveness of initiatives aimed at improving supply chain reliability, responsiveness, flexibility, and cost-effectiveness.
2. Complement quantitative analyses with qualitative investigations is needed to gain a deeper understanding of the contextual factors influencing supply chain performance.
3. A study comparing supply chain performance metrics across different sectors or organizations within the humanitarian aid landscape is needed. By examining variations in practices, strategies, and outcomes, researchers can identify best practices, lessons learned, and transferable knowledge applicable to diverse contexts.
4. Studies exploring the impact of external factors such as political instability, economic fluctuations, and environmental hazards on supply chain resilience and effectiveness are needed Understanding how external shocks influence humanitarian operations can inform the development of adaptive strategies and contingency plans.

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Annex 1: Pearson's correlation coefficient results

Pearson's correlation coefficient results for questionnaire validity testing

	Factors affecting Humanitarian Supply Chain Performance in the ERCS	Obtained Value
1	ERCS uses GPS to make tracking aid deliveries better	.790
2	ERCS practices information communication technology (ICT) to coordinate stakeholders.	.830
3	ERCS uses ICT for inventory management accuracy.	.733
4	There is standardized packaging to safe handling & transportation at ERCS	.881
5	There are standardized quality control measures to check the quality and safety of aid items	.901
6	There is standardized documentation to reduce errors at ERCS.	.859
7	ERCS has long-term collaboration among humanitarian organizations to enhance humanitarian aid delivery.	.899
8	ERCS has local and international partnerships to improve aid distribution.	.937
9	ERCS has swift information sharing practices among stakeholders to improve emergency response.	.839
10	Visionary leadership of ERCS drives innovation in its supply chain management.	.814
11	Transformational leadership of ERCS supports adaptability (Flexibility) of the relief service during crises.	.924
12	There is inspirational motivation leadership commitment in ERCS's supply chain	.881
	Supply Chain Performance Metrics	
1	ERCS consistently and timely develops plans to operate the humanitarian supply chain	.795
2	ERCS manages delivering aid items for the humanitarian supply chain on time.	.774
3	ERCS timely follows up the procurement processes of relief items	.871
4	ERCS's logistics operations prioritize on-time demand fulfillment.	.868
5	Unused and unwanted items are returned through the reverse flow process.	.727
6	ERCS plans timely and quickly to be ready for emergencies	.788
7	Procurement practices of ERCS is timely.	.890
8	ERCS makes ready relief items on timely manner	.881
9	ERCS distributes relief items on timely manner	.796
10	Defective and expired relief items are retuned back to the ERCS office on time	.683
11	There is flexibility at ERCS in preparing supply chain plans.	.808
12	ERCS's procurement activities seek alternative suppliers in flexible approach during crises.	.786
13	ERCS's stocking schedules is flexible during emergencies.	.832
14	ERCS's logistics operations adapt to new delivery routes and transportation modes when needed.	.754
15	ERCS's reverse logistics processes manage the return of defective and expired relief items.	.743
16	ERCS prepares supply chain planning in a cost-effective way	.790
17	ERCS has cost-effective procurement activities	.755
18	ERCS minimizes the cost to make relief items by saving materials and labor cost.	.763
19	ERCS's delivery operations are economical through efficient planning and resource utilization.	.788
20	ERCS manages reverse supply chain operations in cost effective manner.	.658

Annex 2: Survey Questionnaire

ADDIS ABABA UNIVERSITY
SCHOOL OF COMMERCE
Department of Logistics & Supply Chain Management

Questionnaire to be filled by humanitarian supply chain professionals and practitioners at the Ethiopian Red Cross Society (ERCS)

Dear Participant,

This questionnaire has been developed for an academic study aimed at gathering primary data to examine the factors affecting the humanitarian supply chain performance of ERCS (Ethiopian Red Cross Society). It is being conducted as part of the requirements for the Degree of Master of Arts in Logistics and Supply Chain Management at Addis Ababa University, School of Commerce.

All information provided in this questionnaire will be treated with the utmost confidentiality. The data collected will only be used for research purposes. Therefore, I kindly request your open and honest responses to help contribute your expertise and knowledge to this study. Your views are very important in helping the ERCS to enhance its humanitarian supply chain performance.

Your participation is highly valued and appreciated. Thank you for your cooperation and valuable contribution!
If you have any concern on this questionnaire, please don't hesitate to contact me.

Humanity First,

Senait Shimeles
Email: senait.shimelis@redcrosseth.org

Tel: 0911305904

PART I. Section I. Demographic Profile of the Respondents

1. What is your gender?
   Male ☐ Female ☐

2. What is your highest level of education completed?
   Diploma ☐ Bachelor's degree ☐ Master's and above degree ☐

3. How many years have you been involved in humanitarian supply chain management at ERCS?
   Less than 1 year ☐ 1-5 years ☐ 6-10 years ☐ Over 10 years ☐

4. What is your current department/work unit?
   Admin and finance ☐ Field officer ☐
   Project manager ☐ DVM ☐
   Humanitarian supply chain ☐ Delegation Offices ☐
   Disaster Risk Management ☐ Disaster Risk Reduction ☐
   Other ☐

5. In which regional branch do you operate the humanitarian supply chain activities?
   Afar ☐ Sidama ☐
   Tigay ☐ Harari ☐
   Benishangul ☐ Oromia ☐
   Amhara ☐ Gambella ☐
   Dire Dawa ☐ SNNP ☐
   Head Office ☐ Somali ☐

PART II: Please rate your level of agreement on factors that affect humanitarian supply chain performance at ERCS using a 5-point Likert scale, where, 1- Strongly Disagree; 2- Disagree; 3- Neutral; 4- Agree; 5- Strongly Agree

	Factors affecting Humanitarian Supply Chain Performance in the ERCS	Response				
		1	2	3	4	5
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	ERCS uses GPS to make tracking aid deliveries better					
2	ERCS practices information communication technology (ICT) to coordinate stakeholders.					
3	ERCS uses ICT for inventory management accuracy.					
4	There is standardized packaging to safe handling & transportation at ERCS					
5	There are standardized quality control measures to check the quality and safety of aid items					
6	There is standardized documentation to reduce errors at ERCS.					
7	ERCS has long-term collaboration among humanitarian organizations to enhance humanitarian aid delivery.					
8	ERCS has local and international partnerships to improve aid distribution.					
9	ERCS has swift information sharing practices among stakeholders to improve emergency response.					
10	Visionary leadership of ERCS drives innovation in its supply chain management.					
11	Transformational leadership of ERCS supports adaptability (Flexibility) of the relief service during crises.					
12	There is inspirational motivation leadership commitment in ERCS's supply chain					

PART III. Please rate the humanitarian supply chain performance of ERCS using a 5-point Likert scale, where 1- Strongly Disagree; 2- Disagree; 3- Neutral; 4- Agree; 5- Strongly Agree

	Supply Chain Performance Metrics	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
1	ERCS consistently and timely develops plans to operate the humanitarian supply chain					
2	ERCS manages delivering aid items for the humanitarian supply chain on time.					
3	ERCS timely follows up the procurement processes of relief items					
4	ERCS's logistics operations prioritize on-time demand fulfillment.					
5	Unused and unwanted items are returned through the reverse flow process.					
6	ERCS plans timely and quickly to be ready for emergencies					
7	Procurement practices of ERCS is timely.					
8	ERCS makes ready relief items on timely manner					
9	ERCS distributes relief items on timely manner					
10	Defective and expired relief items are retuned back to the ERCS office on time					
11	There is flexibility at ERCS in preparing supply chain plans.					
12	ERCS’s procurement activities seek alternative suppliers in flexible approach during crises.					
13	ERCS’s stocking schedules is flexible during emergencies.					
14	ERCS’s logistics operations adapt to new delivery routes and transportation modes when needed.					
15	ERCS’s reverse logistics processes manage the return of defective and expired relief items.					
16	ERCS prepares supply chain planning in a cost-effective way					
17	ERCS has cost-effective procurement activities					
18	ERCS minimizes the cost to make relief items by saving materials and labor cost.					
19	ERCS’s delivery operations are economical through efficient planning and resource utilization.					
20	ERCS manages reverse supply chain operations in cost effective manner.					

Annex 3: Manuscript for Publication

Determinants of Humanitarian Supply Chain Performance: A Case Study of the Ethiopian Red Cross Society

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Abstract

Ethiopian Red Cross Society's (ERCS) humanitarian supply chain faces operational inefficiencies that hinder its effective aid delivery. This study aims to evaluate the impacts of technology, standardization, collaboration, and leadership on ERCS's humanitarian supply chain performance (HSCP), and identify major performance-affecting factors. The research adopted both descriptive and explanatory. Data collection involved a structured questionnaire distributed via Google Forms to 116 participants selected through a census method. The population comprises ERCS staff involved in supply chain management across regional offices and headquarters. Data analysis includes descriptive and inferential statistics, alongside thematic analysis. Reliability and validity testing were conducted prior to collecting data to ensure the accuracy of the survey tool. The study achieved 81% response rate, indicating high engagement from ERCS staff. Demographic findings showed a diverse workforce across regions and departments. Regarding the HSCP analysis, the result indicates that, among the independent variables, Standardization and Leadership have statistically significant positive impacts on HSCP. Collinearity statistics confirmed good relationships between factors and supply chain performance metrics. The study benefits academia to conduct in-depth studies on how specific aspects of standardization and leadership influence HSCP. It aids ERCS to implement and enforce standard operating procedures across all supply chain operations to improve efficiency. It assists in policy formulation to encourage and facilitate the standardization of HSC processes within ERCS and other aid organizations. Moreover, it helps practitioners to embrace and effectively use technology tools to monitor, manage, and optimize supply chain operations towards ensuring timely and cost-effective aid delivery.

Key words: Humanitarian Supply Chain, Ethiopian Red Cross Society, Technology, Standardization, Collaboration, Leadership

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1. Introduction

The literature defines the supply chain in various ways. Chen & Paulraj (2004) describe it as a network of organizations involved in the production, handling, and distribution of goods and services from suppliers to customers. Effective management of the supply chain is crucial for managing the flow of goods and services (Guo, 2021). Supply chain resilience is essential to adapt to disruptions and maintain operational balance (Ramirez-Pena *et al*., 2019).

A humanitarian supply chain (HSC) supports the transfer of services, supplies, information, and funds among donors, beneficiaries, suppliers, and humanitarian organizations to deliver aid (Gizaw & Gumus, 2016). It involves procurement, transportation, warehousing, and distribution of essential goods and services (Oloruntoba & Gray, 2006). Key pillars include agility, adaptability, and coordination to enhance sustainability and humanitarian efforts (Gheibi *et al*., 2021). The success of humanitarian activities depends on efficient supply chain operations (SCO), highlighting the importance of optimization for effectiveness and cost-efficiency (Nsereko & Nanzekho, 2022). HSCs are vital during natural disasters, such as floods, to alleviate suffering (Kovács & Sigala, 2021; Xu *et al*., 2021). The design and management of HSCs are crucial for timely and effective aid delivery (Dubey, 2022).

Supply chain performance measures how effectively and efficiently it achieves goals like competitiveness, customer satisfaction, and profitability (Gunasekaran *et al*., 2001). Improving HSC performance requires frameworks and indicators for effective measurement and management (Abidi *et al*., 2014). Key performance measures include cost, customer responsiveness, delivery performance, flexibility, logistics cost, and asset management (Beamon, 1999; Cirtita & Glaser-Segura, 2012). This involves integrating information, utilizing appropriate technologies, and defining shared performance metrics (Szymczak *et al*., 2018).

Factors affecting HSCP include flexibility (Beamon, 1999), logistics performance (Green *et al*., 2008), and information technology (Tripathy *et al*., 2016). Risk management, quality management, strategic alignment, leadership, information security management, and government policies also impact success (Dinh *et al*., 2022; Dubey *et al*., 2015; Santarelli *et al*., 2015; Kovács & Sigala, 2021; Nsereko & Nanzekho, 2022; Gheibi *et al*., 2021). Collaborative efforts and strategic decisions further enhance efficiency (Sisay & Liku, 2022).

Collaboration among various entities is crucial for efficient supply chain functioning (Dubey *et al*., 2017). Standardizing processes improves operational effectiveness and fosters collaboration in humanitarian operations (Blecken, 2010). Technological advancements also enhance performance (Belhadi *et al*., 2021). Overall, HSC performance depends on understanding and integrating these factors to deliver aid efficiently. Collaboration among international and local organizations is essential for an efficient and responsive supply chain in humanitarian aid. Ethiopia faces diverse challenges such as droughts, food insecurity, civil unrest, and health crises. Addressing these requires strong HSCP to ensure the welfare of vulnerable citizens. The Ethiopian Red Cross Society (ERCS) plays a key role in delivering aid, collaborating with international agencies, local governments, and NGOs. This study aims to evaluate and examine the factors impacting the overall effectiveness of humanitarian supply chains, focusing on technological advancements, standardization, collaboration, and leadership within the ERCS. Specifically, the study aims to measure the HSCP of ERCS in terms of reliability, responsiveness, agility, and supply chain cost, and to identify the primary factors influencing the HSCP of ERCS. The hypotheses to be tested are: H1a: Technological advancement has a positive and significant effect on HSCP, versus H0a: Technological advancement has no role in HSCP; H1b: Standardization has a positive and significant effect on HSCP, versus H0b: Standardization has no role in HSCP; H1c: Collaboration positively and significantly impacts the performance of HSC, versus H0c: Collaboration has no role in HSCP; and H1d: The effectiveness of leadership significantly influences the performance of HSC, versus H0d: Leadership has no role in HSCP.

2. Related literature review

2.1. Theoretical Literature Review

2.1.1. Humanitarian Supply Chain Performance (HSCP)

Operating in exigent circumstances triggered by natural phenomena or human actions, Humanitarian Supply Chains (HSCs) consist of interconnected global networks (Day *et al*., 2012). Unlike conventional supply chains, HSCs prioritize value addition for beneficiaries in afflicted communities over traditional customers (Blanco & Goentzel, 2006).

Humanitarian Supply Chain Management (HSCM) embodies a multifaceted approach encompassing planning, sourcing, procurement, conversion, and logistics. This process mandates close collaboration with stakeholders such as suppliers, donors, and beneficiaries, integrating supply management and needs assessment, pivotal to operations within global humanitarian organizations (CSCMP, 2011). Efficient management is imperative for humanitarian organizations' core objective: saving lives and mitigating human suffering (Kovacs and Spens, 2007; ICRC, 2010). Utilized by non-profit or donor-funded entities, HSCs manage the efficient flow and storage of goods from origin to consumption to alleviate the plight of vulnerable populations (Oloruntoba & Gray, 2006). This involves various tasks like preparedness, planning, procurement, transportation, warehousing, tracking, and inventory management (Oloruntoba & Gray, 2006). Coordinating and managing HSCs are therefore critical to ensure operational efficiency and value for money in procurement during emergencies. Governments and NGOs are central players in HSCs, with governments exerting significant influence due to their control over political and economic factors. Donors, encompassing both public and private entities, also wield considerable sway, compelling humanitarian organizations to stress accountability and transparency throughout the supply chain (Wassenhove, 2006).

The HSC endeavors to save lives and support beneficiaries amidst irregular demand patterns. Cash donations facilitate procurement, while sorting and prioritizing unsolicited and in-kind donations reduce bottlenecks. Resources, including evacuation vehicles, shelter, and food, with immediate demand requiring nearly zero lead time, form integral parts. The delivery network is ad hoc, and inventory control is challenging due to unpredictable demand. Limited technology and software packages hinder logistics data tracking. Performance is measured by disaster response time, fill rate, and meeting donor expectations. Robust, easily deployable equipment is crucial, while high turnover and voluntary staffing pose human resource challenges. Stakeholders include donors, governments, NGOs, and the United Nations (Ertem *et al*., 2010).

HSCs face challenges such as inadequate logistics infrastructure and unpredictable shifts in relief supply origins and destinations. Additionally, donors often earmark funds for specific materials or locations, overlooking indirect services like staff training and disaster preparedness (Oloruntoba & Gray, 2006). Therefore, managing HSCs entails not only delivering aid but also addressing donor expectations and stakeholder value.

Humanitarian Supply Chain Management (HSCM) promptly responds to disasters, aiming to save lives and alleviate suffering. It entails efficiently managing various elements like information, goods, human resources, and infrastructure to minimize the disaster's impact on affected populations (Lijo & Ramesh, 2012). Information technology (IT) plays a crucial role in HSCM, akin to commercial supply chain management. IT tools such as intranets, extranets, electronic data interchange, videoconferencing, and communication devices like mobile phones and radios are instrumental. A typical HSC route spans from donors to consumers, with donors and beneficiaries serving as customers, while donors and paid suppliers act as suppliers (Charles *et al*., 2010; Oloruntoba & Gray, 2009).

Humanitarian Supply Chain Performance (HSCP) management plays a pivotal role in ensuring the effectiveness of humanitarian efforts by establishing strategic goals and directing performance towards those objectives. This involves employing measurement tools to evaluate outcomes and improve organizational processes (Ariyachandra & Frolick, 2008). Various models and metrics have been developed to measure and manage performance in HSCs, emphasizing factors such as strategic planning, resource management, technology utilization, and supplier relations (Pettit & Beresford, 2009). Despite challenges in adapting traditional models like the balanced scorecard to the dynamic and complex humanitarian context, tailored frameworks such as the Supply Chain Operations Reference Model (SCOR) have been developed (Blecken, 2010; Parris, 2013). These efforts aim to enhance performance measurement and management in humanitarian operations, particularly in emergency relief efforts (Beamon & Balcik, 2008; Schulz & Heigh, 2009; Blecken *et al*., 2009).

2.1.2. Supply Chain Performance Models

Various models are available for evaluating supply chain performance. Examples include the Framework for Logistics Research (FLR), GSCF framework, Strategic Audit Supply Chain (SASC), World Class Logistics (WCL) model, AFNOR model, Balanced Scorecard (BSC), Strategic Profit Model (SPM), American Production And Inventory Control Society (APICS) model, European Foundation for Quality Management (EFQM) Excellence Model, and Supply Chain Operations Reference (SCOR) Model. These models have been thoroughly elaborated by Estampe (2014):

Framework for Logistics Research (FLR) - Developed in the 1990s, this model evaluates the alignment of supply chain decisions with a company's strategic goals, offering a holistic framework for strategic planning and operational effectiveness.

GSCF framework - Developed by the Ohio State University (OSU) in 1994, it provides flexibility in decision-making levels (strategic, tactical, and operational) and emphasizes the correlation between supply chain processes and structure.

Strategic Audit Supply Chain (SASC) - Introduced in 1999, this model assesses supply chains by examining processes, IT technologies, and organizational structures, primarily focusing on internal company performance analysis.

World Class Logistics (WCL) model- Developed by Michigan State University in the 1990s, it evaluates company performance by focusing on effective management of inter-organizational relationships within the supply chain.

AFNOR model - Developed in 2008, this model presents a structured analysis procedure from company strategy to performance indicator implementation, enabling measurement of logistics performance through suggested indicators.

Balanced Scorecard (BSC) - Developed in the 1990s, it aims to supplement financial performance indicators with functional indicators, advocating for equilibrium and alignment with company strategy.

Strategic Profit Model (SPM) - Originating from research conducted at Ohio State University in 2000, this model integrates actors within the supply chain and focuses on strategic and financial application.

American Production and Inventory Control Society (APICS) model - This model promotes an organizational management strategy centered around anticipation and resource planning, mainly designed for manufacturing firms.

Supply Chain Operations Reference (SCOR) Model - Developed by the Supply Chain Council (SCC) in 1996, it offers a standardized approach for assessing and describing supply chain processes, applicable across manufacturing and service industries.

2.1.2. HSCP Model and Attributes

Performance assessment within humanitarian organizations lags behind the commercial sector. Unlike well-established frameworks for commercial enterprises, there is no universally recognized performance measurement framework for humanitarian organizations. Consequently, most performance measurement frameworks in this sector are borrowed from commercial metrics, although many are found to be inappropriate. The SCOR model has been widely employed for assessing and enhancing supply chain

performance in humanitarian organizations, furnishing them with an extensive array of processes and best practices to gauge and analyze their operations. Adaptations of the SCOR model for humanitarian use have excluded certain processes like manufacturing and returned items handling, and have added elements like storage processes, aligning performance assessment with quality, time, and cost dimensions. Five essential performance attributes identified by the SCOR model, namely delivery reliability, responsiveness, agility (flexibility), supply chain cost, and asset management efficiency, serve as pivotal factors for success in supply chain performance. These performance attributes and their definitions are outlined in Table 1.

The SCOR model, integrating business processes, metrics, best practices, and technology to boost supply chain efficiency, proves invaluable as a performance measurement tool in humanitarian supply chains (Lu *et al*., 2016). Yet, while it effectively gauges performance in humanitarian logistics, the asset attribute holds diminished relevance for Humanitarian Relief Organizations. These entities typically lack significant fixed assets or manufacturing facilities (Lu *et al*., 2016).

Table 1: Performance attribute, metrics and description (Bolstorff & Rosenbaum, 2012).

Customer Focus	Metric	Description
Supply chain (SC) Reliability & Quality	Perfect Order Fulfillment	How well the supply chain delivers exactly what the customer ordered.
SC Responsiveness & Timeliness	Order Fulfillment Cycle Time	How fast the customer receives their order.
SC Agility	Supply Chain Flexibility & Adaptability	How quickly the supply chain can adjust to meet changing demands.
SC Cost	Supply Chain Management Cost	The total cost of running the supply chain.
SC Asset Management	Cash-to-Cash Cycle Time & Return on Assets	How efficiently the supply chain uses its resources (inventory, equipment, etc.)

Supply Chain Reliability stands as a cornerstone in logistics operations, underlining the imperative of maintaining consistent quality standards throughout the supply chain. In humanitarian contexts, where timely aid delivery is critical, Supply Chain Responsiveness assumes paramount importance. This aspect underscores the supply chain's ability to promptly address urgent needs, emphasizing the need to minimize response time to swiftly assist those in crisis. Supply Chain Cost metrics serve as indicators of financial performance, offering insights into resource utilization efficiency within the supply chain. Moreover, Agility emerges as a crucial attribute, particularly in emergency relief efforts, reflecting the supply chain's capacity to swiftly adapt to sudden demand fluctuations. Together, these factors bolster the resilience and efficacy of HSCs, ensuring efficient and effective aid delivery to affected populations (Garcia *et al*., 2012).

This study adopts the SCOR model as a reference, focusing on its four performance attributes: reliability, responsiveness, agility, and cost, while excluding the asset attribute due to its diminished relevance for Humanitarian Relief Organizations as stated by Lu *et al*. (2016).

2.2. Empirical Literature Review

2.2.1 Factors Affecting HSCP

Technological advancements, standardization, collaboration, and leadership are pivotal factors enhancing the performance of Humanitarian Supply Chains (HSCs). They contribute significantly to operational effectiveness, efficiency, cooperation, and coordination.

2.2.1.1 Technological Advancements

Technological advancements are crucial for shaping the performance of HSCs, enabling humanitarian organizations to enhance Supply Chain Operations (SCOs) and overall performance. The literature emphasizes agility, adaptability, and alignment as critical aspects for improving humanitarian logistics (Dubey *et al*., 2015). Information processing technologies, in particular, enhance organizational agility within humanitarian supply chains (Dubey *et al*., 2020), while technological solutions bolster resilience, as observed during evaluations in flood disasters (Xu *et al*., 2021). Performance measurement is vital in humanitarian supply chains, with critical success factors and performance indicators playing key roles in evaluation and management (Santarelli *et al*., 2015; Abidi *et al*., 2014).

The adoption of technological advancements enhances the value of humanitarian supply chains (Abidi *et al*., 2015), and tools like interpretive structural modeling aid in identifying barriers and improving aid dissemination (Rahman *et al*., 2022). Technology, such as the 3-R principle (right time, right place, right material), helps pinpoint gaps in relief supply chains' response to natural disasters (Antai *et al*., 2015). Innovation in humanitarian logistics through technological advancements improves efficiency and effectiveness (Altay *et al*., 2023), particularly when focusing on organizational information processing to enhance agility (Dubey *et al*., 2020).

2.2.1.2 Standardization

Standardization significantly influences the performance of HSCs, enhancing efficiency and operational effectiveness. It involves developing and implementing uniform guidelines, protocols, and procedures across supply chain activities (Rahman *et al*., 2022). The efficiency of supply chains in humanitarian operations depends on standardization, encompassing technical and procedural standards crucial for sustainability and competitiveness (Nsereko & Nanzekho, 2022).

Studies underscore the importance of standardized data and distribution processes in enhancing HSC flexibility (Xu *et al*., 2021). A systematic literature review categorizes performance measurement indicators, essential for assessing and improving humanitarian supply chain performance (Abidi *et al*., 2014). Standardization fosters transparency and accountability in operations, crucial for meeting donor agency criteria (Lwin *et al*., 2022). It also supports agility and responsiveness, essential for managing dynamic humanitarian crises (Oloruntoba & Gray, 2006).

2.2.1.3 Collaboration

Collaboration is fundamental in humanitarian supply chains, facilitating stakeholder coordination and effective aid delivery. It involves partnerships among governments, aid agencies, NGOs, the private sector, and local communities to leverage resources and expertise in crisis response (Dubey *et al*., 2017). Collaboration is critical for achieving common goals and responding swiftly to crises, differing from traditional supply chains due to unique uncertainties and challenges (Sabri *et al*., 2019).

Digital technologies enhance collaboration in HSCs, improving information visibility and stakeholder engagement (Dubey, 2022). Cloud computing, for instance, supports collaboration by providing robust models for stakeholder interaction (Schniederjans *et al*., 2016). Collaboration in HSCs promotes integration, resilience, and sustainability through shared knowledge and resources (Besiou & Wassenhove, 2020).

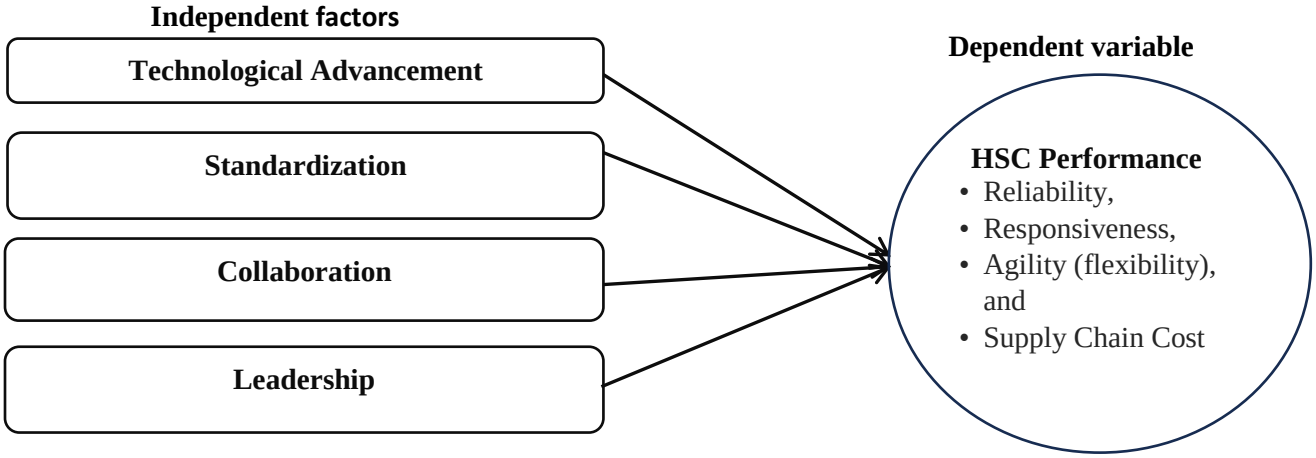
2.2.1.4 Leadership

Effective leadership plays a crucial role in shaping HSC performance by influencing coordination, decision-making, innovation, and resilience (Fiorini *et al*., 2021). Leadership theories, such as intergroup leadership and crisis management, highlight leadership's role in fostering collaboration and managing emergencies within supply chains (Dubey *et al*., 2020). Leadership qualities like crisis management and decision-making are essential for ensuring HSC resilience and efficiency (Dubey, 2022).

Leadership in HSCs promotes collaboration, innovation, and strategic direction, crucial for managing dynamic humanitarian crises (Oloruntoba & Gray, 2006). Transformational leadership, in particular, integrates risk management and performance to enhance supply chain resilience (Phung *et al*., 2022). Effective leadership empowers teams, fosters innovation, and drives continuous improvement in SCOs (Michel *et al*., 2023).

2.3. Conceptual Framework

This conceptual framework outlines the factors affecting HSCP.



(Source: Lu et al., 2016)

3. Research Methodology

3.1. Study Area Description

The study focuses on the ERCS, established in 1935 in response to Italian aggression in Ethiopia. Aligned with the principles of the International Red Cross and Red Crescent Movement, ERCS upholds humanity, impartiality, neutrality, independence, voluntary service, unity, and universality.

ERCS's mandate includes providing humanitarian services to vulnerable populations in Ethiopia. These services encompass disaster response and preparedness, health services, first aid and ambulance services, water and sanitation initiatives, and resilience-building community programs. Operating nationally, regionally, and locally, ERCS collaborates with government agencies, NGOs, and international partners to address humanitarian needs, advocate for human rights, and promote social inclusion.

Reorganized in 2014, ERCS's structure includes departments like Disaster Preparedness and Response (DPR) and Disaster Risk Reduction (DRR), which play crucial roles in its humanitarian efforts.

3.2. Research Design

The study employs both descriptive and explanatory research designs to explore factors affecting HSCP. Data collection involved administering a structured questionnaire via Google Forms to 116 participants selected through a census method. The questionnaire included multiple-choice and Likert-scale items focusing on technological advancements, standardization, collaboration, and leadership factors influencing HSCP. Quantitative analysis using statistical software (SPSS and Excel) was utilized to analyze collected data.

3.3. Research Approach
A mixed-methods approach integrated qualitative methods to capture participants' perceptions and experiences regarding supply chain challenges and opportunities. Qualitative methods were particularly employed to investigate subjective aspects of HSCP, complementing quantitative analysis that focused on objective supply chain practices. This methodological blend aims to provide a comprehensive understanding of HSCP at ERCS, enhancing humanitarian logistics management.

3.4. Data Sources
The study gathered primary data through the structured questionnaire to obtain firsthand insights into factors influencing HSCP at ERCS. Secondary data were sourced from published and unpublished documents that provide context and background on HSCP factors in ERCS.

3.5. Data Collection Methods
Data collection utilized Google Forms, offering flexibility and accessibility for participants to respond from any location with internet access. Participants received email invitations containing a direct link to the questionnaire, with reminder notifications to encourage participation. The structured survey format ensured standardized responses and streamlined data collection. Secondary data collection involved reviewing literature on HSCP factors specific to ERCS.

3.6. Population
Respondents were selected using a census method, encompassing 116 participants involved in Humanitarian Supply Chain Management (HSCM) practices at ERCS. This approach included individuals from ERCS's eleven regional offices across Ethiopia and its headquarters in Addis Ababa, ensuring diverse perspectives and comprehensive data alignment with research objectives.

3.7. Data Analysis and Presentation Methods
Data analysis used quantitative techniques like descriptive statistics (frequencies, percentages, means, standard deviations) via SPSS and Excel. Inferential statistics (regression analysis, chi-square tests, t-tests) explored variable relationships and significant differences.

3.8. Reliability and Validity Testing
Cronbach's alpha assessed the internal consistency of the questionnaire. A pilot study with logistics staff ensured reliability, with alpha values above 0.70. Most variables showed strong consistency, with values from 0.714 to 0.915. High scores for Standardization (0.900) and Reliability (0.915) indicate well-represented constructs. The survey was reliable for further analysis in supply chain management studies.

4. Results and Discussion
4.1. Response Rate
The response rate is crucial for data quality in survey research (Fan & Yan, 2010). This study achieved an 81% response rate, with 94 of 116 questionnaires completed, indicating strong respondent engagement. This high rate suggests genuine effort to provide valuable data, enhancing the study's credibility. While there is no universal standard, a 60-70% response rate is often targeted to ensure reliability (Nulty, 2008).

4.2. Demographic Profile of the Respondents
The survey shows diverse educational qualifications among respondents. Most have advanced degrees (54.3%, n = 51), with a majority being male (n = 40 males, n = 11 females). Bachelor's degree holders make up 40.4% (n = 38), mostly male (n = 25 males, n = 13 females). A small group (5.3%, n = 5) has a diploma (1 male, 4 females). Overall, 66 males and 28 females participated. Experience varies

significantly. Most (42.6%, n = 40) have 1-5 years of experience (27 males, 13 females). Those with 6-10 years account for 27.7% (n = 26; 16 males, 10 females). Over 10 years of experience is held by 21.3% (n = 20; 17 males, 3 females). A small group (8.5%, n = 8) has less than 1 year (6 males, 2 females). Respondents are spread across ERCS departments. The largest group (16.0%, n = 15) is in HSC, followed by Disaster Risk Management (13.8%, n = 13). Project Manager (12.8%, n = 12), Field Officer (10.6%, n = 10), and DVM (9.6%, n = 9) follow. Administration and Finance, Delegation Officer, and Disaster Risk Reduction each have 8.5% (n = 8). Other units account for 11.7% (n = 11).

Respondents are spread across ERCS branches, with 23.4% (22 individuals) at the Head Quarter. Tigray and Oromia each account for 11.7% (11 individuals), followed by Amhara at 10.6% (10 individuals). The Somali region includes 6.4% (6 individuals), and Sidama, SNNP, and Dire Dawa each have 5.3% (5 individuals). Afar accounts for 4.3% (4 individuals), Benishangul for 9.6% (9 individuals), and both Harari and Gambella each for 3.2% (3 individuals). Understanding respondent characteristics is crucial for research reliability and validity (Leone *et al*., 2022; Berinsky *et al*., 2012). This distribution shows a diverse and experienced workforce within the ERCS.

4.3. Factors affecting HSCP:Descriptive analysis

Managing HSCs are important to improve the performance of aid organizations in delivering timely and effective assistance to communities in need (Peter, 2020). Yet, various factors affect HSCP (Nsereko & Nanzekho, 2022). This section investigates the impact of technological advancements, standardization practices, collaboration efforts, and leadership qualities on the humanitarian supply chain performance (HSCP) at the ERCS. Each sub-section examines how these factors enhance efficiency, coordination, and responsiveness in aid delivery. The analysis includes mean scores and standard deviations and evaluated agains the Mean Range Interpretation as shown in Table 2, supported by relevant literature underscoring their importance in humanitarian operations. The analysis mean score resultss are indicated in Table 3.

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Table 2. Mean Range Interpretation (Best, 1997)

1.00-1.80	Very Uninfluential
1.81-2.41	Uninfluential
2.42-3.23	Moderately Influential
3.24-4.03	Influential
4.04-5.00	Very Influential

4.3.1. Technological Advancements

Table 3 summarizes the impact of technological measures on the humanitarian supply chain efficiency at ERCS. Evaluated indicators include GPS for aid shipment monitoring, ICT for stakeholder coordination, and ICT for inventory management accuracy, categorized into five levels with mean scores and standard deviations provided.

Interpreting mean scores from Table 2, the findings indicate ERCS's technological interventions moderately influence HSCP. For instance, GPS tracking received a mean score of 3.13 (SD 0.93), ICT for stakeholder coordination and inventory management accuracy scored 3.28 (SD 0.86) and 3.31 (SD 0.83) respectively, falling within the Moderately Influential and Influential range. According to Xu *et al*. (2021), integrating technologies enhances supply chain performance, adds value to HSCs (Abidi *et al*., 2015), and improves HSCP (Haavisto & Kovacs, 2015). On average, ERCS's technological advancements in HSCP have a mean score of 3.24, suggesting moderate staff appreciation, particularly for ICT in stakeholder coordination and inventory management Standard deviations (0.83 to 0.93) indicate consistent respondent views on these technological practices. According to Xu *et al*. (2021), technology enhances supply chain performance, adds value to HSCs (Abidi *et al*., 2015), and improves HSCP

(Haavisto & Kovacs, 2015). However, lower utilization suggests room for operational efficiency improvements via technology (Santarelli *et al*., 2015).

Table 3: Impact of Technological Advancements, Standardization, Collaboration and Leadership on HSCP

Technological Advancements Indicators	SD	D	N	A	SA	Mean	Stdv
ERCS uses GPS to make tracking aid deliveries better	2	27	24	39	2	3.13	0.93
ERCS practices information communication technology (ICT) to coordinate stakeholders.	3	15	30	45	1	3.28	0.86
ERCS uses ICT for inventory management accuracy.	3	12	33	45	1	3.31	0.83
			Mean Average			**3.24**	
Standardization Indicators	SD	D	N	A	SA	Mean	Stdv
There is standardized packaging to safe handling of relief items & transportation at ERCS	2	8	35	47	2	3.41	0.768
There are standardized quality control measures to check the quality and safety of aid items	2	5	30	54	3	3.54	0.743
There is standardized documentation to reduce errors at ERCS.	2	5	28	56	3	3.56	0.741
Mean Average						**3.5**	
Collaboration Indicators	SD	D	N	A	SA	Mean	Stdv
ERCS has long-term collaboration among humanitarian organizations to enhance humanitarian aid delivery.	5	0	9	60	20	3.96	0.891
ERCS has local and international partnerships to improve aid distribution.	4	1	4	66	19	4.01	0.823
ERCS has fast information sharing practices among stakeholders to improve emergency response.	2	2	17	57	16	3.88	0.788
			Mean Average			**3.95**	
Leadership Indicators	SD	D	N	A	SA	Mean	Stdv
Visionary leadership of ERCS drives innovation in its supply chain management.	3	7	31	49	4	3.47	0.826
Transformational leadership of ERCS supports adaptability (Flexibility) of the relief service during crises.	5	3	25	58	3	3.54	0.838
There is inspirational motivation leadership commitment in ERCS's supply chain	4	4	23	58	5	3.6	0.834
			Mean Average			**3.54**	

NOTE: SD- Strongly Disagree, D- Disagree, N-Neutral, A- Agree, SA- Strongly Agree
Source: Self-conducted survey, 2024

4.3.2. Standardization

Table 3 outlines standardization's impact on HSCP, focusing on standardized packaging, quality control measures, and documentation to reduce errors. Standardization is crucial for HSCP (Xu *et al*., 2021), enhancing efficiency, accuracy, and safety (Rahman *et al*., 2022; Santarelli *et al*., 2015). Mean scores from Table 2 indicate ERCS's practices significantly impact HSCP: packaging scored 3.41 (SD 0.768),

quality control 3.54 (SD 0.743), and documentation 3.56 (SD 0.741), all falling within the Influential range. These findings underscore the importance of standardized practices in improving humanitarian aid delivery at ERCS, ensuring efficient and safe operations.

4.3.3. Collaboration

Table 3 outlines collaboration's impact on HSCP, focusing on long-term partnerships, local and international aid distribution, and rapid information sharing. Collaboration is essential for effective coordination and trust among humanitarian actors (Dubey *et al*., 2017), and is facilitated by digital technologies to enhance integration and resource mobilization (Dubey, 2022). ERCS's collaboration efforts significantly impact HSCP, with long-term partnerships scoring 3.96 (SD 0.89), local and international collaborations 4.01 (SD 0.823), and rapid information sharing 3.88 (SD 0.788), all within the Influential range.

These findings highlight the crucial role of collaboration in improving the efficiency, coordination, and responsiveness of HSC operations at ERCS, emphasizing the importance of fostering relationships with various stakeholders for effective aid delivery (Chari *et al*., 2021).

4.3.4. Leadership

Table 3 also examines leadership's impact on HSCP, focusing on visionary, transformational, and inspirational motivation leadership within ERCS's supply chain. Effective leadership is crucial for shaping HSCP (Fiorini *et al*., 2021) and is a critical success factor in humanitarian logistics (Dubey *et al*., 2015), significantly driving effective crisis response and aid delivery (Agarwal *et al*., 2020). ERCS's leadership qualities significantly influence HSCP, with visionary leadership scoring 3.47 (SD 0.826), transformational leadership 3.54 (SD 0.838), and inspirational motivation leadership 3.6 (SD 0.834), falling within the Influential ranges.

These findings highlight the essential roles of different leadership styles in driving innovation, adaptability, and commitment within ERCS's HSC, underscoring the importance of effective leadership in navigating challenges and ensuring successful aid delivery. On average, leadership practices at ERCS have a mean score of 3.54, indicating a generally influential view with consistent agreement among employees on these practices.

4.4. Humanitarian supply chain performance (HSCP):Descriptive analysis

Assessing humanitarian supply chain performance is important for enhancing efficacy and efficiency (Chari *et al*., 2020; D'Haene *et al*., 2015). Identifying critical success factors and performance indicators is essential for managing and evaluating performance (Santarelli *et al*., 2015; Abidi *et al*., 2014). This study analyzes four humanitarian supply chain performance metrics as shown in Table 4.

Table 4: Reliability, Responsiveness, Flexibility and Supply Chain Cost as factors measuring HSCP

Reliability Metrics	SD	D	N	A	SA	Mean	Stdv
ERCS consistently and timely develops plans to operate the humanitarian supply chain	1	8	24	57	4	3.59	0.754
ERCS manages delivering aid items for the humanitarian supply chain on time.	4	7	27	55	1	3.45	0.825
ERCS timely follows up the procurement processes of relief items	3	4	24	57	6	3.63	0.803
ERCS's logistics operations prioritize on-	2	7	25	51	9	3.62	0.844

time demand fulfillment.							
Unused and unwanted items are returned through the reverse flow process.	1	6	30	47	10	3.63	0.803
					Mean Average	**3.584**	
Responsiveness Metrics	SD	D	N	A	SA	Mean	Stdv
ERCS plans timely and quickly to be ready for emergencies	2	5	26	60	1	3.56	0.712
Procurement practices of ERCS is timely.	2	7	29	55	1	3.49	0.744
ERCS makes ready relief items on timely manner	3	5	27	57	2	3.53	0.772
ERCS distributes relief items on timely manner	2	6	30	54	2	3.51	0.744
Defective and expired relief items are retuned back to the ERCS office on time	2	3	25	58	6	3.67	0.739
					Mean Average	**3.552**	
Flexibility Metrics	SD	D	N	A	SA	Mean	Stdv
There is flexibility at ERCS in preparing supply chain plans.	2	2	27	55	8	3.69	0.748
ERCS's procurement activities seek alternative suppliers in flexible approach during crises.	1	5	25	51	12	3.72	0.765
ERCS's stocking schedules is flexible during emergencies.	2	2	22	64	4	3.70	0.685
ERCS's logistics operations adapt to new delivery routes and transportation modes when needed.	3	3	24	60	4	3.63	0.762
ERCS's reverse logistics processes manage the return of defective and expired relief items.	2	3	25	54	10	3.71	0.785
					Mean Average	**3.69**	
Cost Metrics	SD	D	N	A	SA	Mean	Stdv
ERCS prepares supply chain planning in a cost-effective way	4	1	18	63	8	3.74	0.802
ERCS has cost-effective procurement activities	2	1	22	59	10	3.79	0.731
ERCS minimizes the cost to make relief items by saving materials and labor cost.	0	2	19	66	7	3.83	0.58
ERCS's delivery operations are economical through efficient planning and resource utilization.	3	2	10	70	9	3.85	0.747
ERCS manages reverse supply chain operations in cost effective manner.	0	4	20	62	8	3.79	0.654
					Mean Average	**3.80**	

4.4.1. Reliability

Table 4 evaluates reliability in measuring HSCP, focusing on timely operational plans, on-time aid delivery, procurement follow-up, on-time demand fulfillment, and reverse flow processes for returning unused items. The findings, based on the Mean Range Interpretation from Table 2, indicate that reliability metrics significantly enhance HSCP within ERCS. For example, timely development of operational plans

scored 3.59 (SD 0.754), timely follow-up of procurement processes and reverse flow processes both scored 3.63 (SD 0.803), and prioritizing on-time demand fulfillment scored 3.62 (SD 0.803), all within the Influential range.

These results highlight the importance of reliability for efficient HSCs. Timely planning, procurement, and logistics operations are essential for promptly meeting the needs of affected populations. Additionally, reverse flow processes help reduce waste and optimize resources, further enhancing supply chain reliability and performance.

4.4.2. Responsiveness

Table 4 evaluates responsiveness in measuring HSCP, focusing on timely emergency planning, procurement practices, readiness and distribution of relief items, and the prompt return of defective and expired items to ERCS offices. The findings, based on the Mean Range Interpretation from Table 2, show that responsiveness metrics significantly influence HSCP within ERCS. For instance, timely emergency planning scored 3.56 (SD 0.712), procurement practices 3.49 (SD 0.744), readiness of relief items 3.53 (SD 0.772), distribution of relief items 3.51 (SD 0.744), and return of defective items 3.67 (SD 0.739), all within the Influential range.

These results highlight the critical role of responsiveness in addressing humanitarian crises and ensuring timely aid delivery. Effective emergency planning, procurement, readiness, distribution, and defective item management are essential for enhancing HSC efficiency and effectiveness, ultimately leading to better outcomes for those in need.

4.4.3 Flexibility (Agility)

Table 4 evaluates flexibility (agility) in measuring HSCP, focusing on supply chain plan preparation, alternative suppliers during crises, flexible stocking schedules, adapting logistics to new routes and modes, and reverse logistics for defective items. Mean scores based on Table 2 indicate that flexibility metrics significantly influence HSCP within ERCS. Flexibility in supply chain planning scored 3.69 (SD 0.748), alternative suppliers during crises 3.72 (SD 0.765), flexible stocking schedules 3.70 (SD 0.685), adapting logistics 3.63 (SD 0.762), and reverse logistics 3.71 (SD 0.785), all within the Influential ranges.

These findings underscore the importance of flexibility in effectively responding to humanitarian crises and ensuring timely, efficient aid delivery. Flexibility in planning, procurement, stocking, logistics, and reverse logistics enables ERCS to adapt to changing circumstances, optimizing response efforts and improving outcomes for those in need.

4.4.4. Supply Chain Cost

Table 4 assesses supply chain cost in measuring HSCP, focusing on metrics like cost-effective planning, procurement, production efficiency, economical delivery, and managing reverse logistics. Based on Table 2's Mean Range Interpretation, ERCS's cost metrics significantly impact HSCP. For instance, cost-effective planning scored 3.74 (SD 0.80), procurement 3.79 (SD 0.731), production efficiency 3.83 (SD 0.58), economical delivery 3.85 (SD 0.747), and reverse logistics 3.79 (SD 0.654), all within the Influential range.

These findings emphasize cost-effectiveness in HSCM, where efficient planning, procurement, production, delivery, and reverse logistics enhance aid impact while optimizing resources. By minimizing costs and maximizing efficiency, ERCS extends aid reach, enhancing humanitarian delivery's effectiveness and sustainability (Nsereko & Nanzekho, 2022).

4.5. Analysis of Collinearity Statistics for key factors influencing supply chain performance metrics

Multicollinearity in regression analysis complicates the interpretation of individual variable effects on the response (Graham, 2003), leading to unstable estimates and invalid inferences (Vatcheva *et al*., 2016). Table 5 displays collinearity statistics for independent variables—Technological Advancements, Standardization, Collaboration, and Leadership—across four dependent variables: Reliability, Responsiveness, Flexibility, and Supply Chain Cost. In multiple linear regression, multicollinearity arises when predictors are highly correlated, obscuring their individual impacts. Diagnostic measures like Variance Inflation Factor (VIF) and tolerance values assess this issue (Senaviratna & Cooray, 2019). Tolerance values near 1 indicate low collinearity, while VIF values above 10 suggest high collinearity. The study finds consistent VIF values below 10 and tolerance values above 0.1 for all dependent variables, indicating minimal multicollinearity among the independent variables (Table 5). This stable relationship ensures reliable assessments of the independent variables' impacts on each dependent variable.

Table 5. Multi collinearity test result of independent variable

Dependent Variable	**Independent variable**	**Collinearity Statistics**	
		Tolerance	**VIF**
Reliability	Technological Advancements	.724	1.382
	Standardization	.552	1.810
	Collaboration	.650	1.538
	Leadership	.561	1.782
Responsiveness	Technological Advancements	.724	1.382
	Standardization	.552	1.810
	Collaboration	.650	1.538
	Leadership	.561	1.782
Flexibility	Technological Advancements	.724	1.382
	Standardization	.552	1.810
	Collaboration	.650	1.538
	Leadership	.561	1.782
Supply Chain Cost	Technological Advancements	.724	1.382
	Standardization	.552	1.810
	Collaboration	.650	1.538
	Leadership	.561	1.782

Source: Self-conducted survey, 2024

4.6. Inferential statistics for metrics measuring HSCP at ERCS

Santarelli *et al*. (2015) suggest that analyzing real results and implementing performance measurement systems can lead to identifying best practices for improving the efficiency and effectiveness of HSCs. In this study, multiple linear regression analyses were conducted to examine the effects of *Technological Advancements, Standardization, Collaboration,* and *Leadership* on four dependent metric variables, i.e., *Reliability, Responsiveness, Flexibility,* and *Supply Chain Cost*. The results provide an understandings of the influence of these predictor metrics on each outcome.

4.6.1 Reliability as Measures of HSCP

A multiple linear regression analyzed Technological Advancements, Standardization, Collaboration, and Leadership's impact on Reliability. The model was significant ($F(4, 89) = 12.332$, $p < .001$) and explained 35.7% of reliability variance ($R^2 = .357$, adjusted $R^2 = .328$). The Durbin-Watson statistic (1.960) showed no significant autocorrelation.

ANOVA confirmed model significance, $R^2 = .357$, $F(4, 89) = 12.332$, $p < .001$. The Regression Coefficients indicate Standardization ($\beta = .327$, $p = .005$) and Leadership ($\beta = .360$, $p = .002$). This confirmed that Standardization and Leadership positively impact Reliability. The Regression Equation is:
Reliability = 1.477 + (0.322 × Standardization) + (0.322 × Leadership) + 0.05ε

4.6.2 Responsiveness as Measures of HSCP

A multiple linear regression explored Technological Advancements, Standardization, Collaboration, and Leadership's impact on Responsiveness. The model was significant ($F(4, 89) = 22.118$, $p < .001$) and explained 49.9% of responsiveness variance ($R^2 = .499$, adjusted $R^2 = .476$). Standardization ($\beta = .504$, $p < .001$) significantly influenced Responsiveness. The Durbin-Watson statistic (1.661) indicated no significant autocorrelation. The Regression Equation is:
Responsiveness = 1.025 + (0.458 × Standardization) + 0.05ε

4.6.3 Flexibility as Measures of HSCP

A multiple linear regression examined Technological Advancements, Standardization, Collaboration, and Leadership's impact on Flexibility. The model was significant ($F(4, 89) = 15.057$, $p < .001$) and explained 40.4% of flexibility variance ($R^2 = .404$, adjusted $R^2 = .377$), Standardization ($\beta = .269$, $p = .016$) and Leadership ($\beta = .455$, $p < .001$) significantly and positively impact influenced Flexibility The Durbin-Watson statistic (1.625) showed no significant autocorrelation. The Regression Equation is:
Flexibility = 1.669 + (0.241 × Standardization) + (0.370 × Leadership) + 0.05ε

4.6.4 Leadership as Measures of HSCP

A multiple linear regression assessed Technological Advancements, Standardization, Collaboration, and Leadership's impact on Supply Chain Cost. The model was significant ($F(4, 89) = 16.839$, $p < .001$) and explained 43.1% of supply chain cost variance ($R^2 = .431$, adjusted $R^2 = .405$). The Regression Coefficients indicate that Standardization ($\beta = .327$, $p = .003$) and Leadership ($\beta = .270$, $p = .013$) significantly influenced Supply Chain Cost. The Durbin-Watson statistic (1.853) indicated no significant autocorrelation. The Regression Equation is:
Supply Chain Cost = 1.656 + (0.262 × Standardization) + (0.197 × Leadership) + 0.05ε

4.6.5 Regression Summary Result for HSCP

A multiple linear regression was conducted to assess the impact of Leadership, Technological Advancements, Collaboration, and Standardization on the composite measure of High-Performance Supply Chain (HSCP).

The regression model showed a strong positive relationship with HSCP, with an R value of 0.731 and an R^2 of 0.535, indicating that 53.5% of the variability in HSCP can be explained by the independent variables. The model's F-statistic was 25.569, significant at $p < .001$, indicating a good fit.

Regression Coefficients indicateing Standardization ($\beta = 0.410$, $p = .000$) and Leadership ($\beta = 0.368$, $p = .000$) showed that both positively and significantly impact HSCP, while Technological Advancements and Collaboration showed non-significant effects.
The Regression Equation is:
HSCP = 1.457 + (0.321 × Standardization) + (0.262 × Leadership) + 0.05ε

4.6.6. Regression analysis results relative to the study hypothesis

Regression analysis is a statistical tool widely used in various fields; it involves fitting a mathematical model to data to understand the relationship between variables. It provides insights for policy development (Schaik *et al*., 2019). Moreover, it is used to extract generalizable results (Hay & Knechel, 2016). In this study, multiple regression analysis were tested for the four supply chain performance metrics (*Reliability, Responsiveness, Flexibility, and Leadership*), computed as one dependent variable,

i.e., HSCP and were regressed against the four independent variable (*Leadership, Technological Advancements, Collaboration, and Standardization*) to test the hypothesis. The hypothesis test result is indicated in Table 6. The regression results highlight that Standardization and Leadership are critical for enhancing HSCP, while Technological Advancements and Collaboration do not show significant effects in this study.

Table 6. Hypothesis testing result and desion

Hypothesis	Unstandardized Coefficients B	Standardized Coefficients Beta (β)	P-value	Decision
$H1_a$: Technological advancement has positive and significant effect on HSCP	-.028	-.037	.667	*$H1_a$:* Rejected *$H0_a$:* Accepted
$H1_b$: Standardization has a positive and significant effect on the HSCP	.321	.410	<0.01	*$H1_b$:* Accepted *$H0_b$:* Rejected
$H1_c$: Collaboration positively and significantly impacts the performance of HSC.	.060	.087	.337	*$H1_c$:* Rejected *$H0_c$:* Accepted
$H1_d$: The effectiveness of leadership significantly influences the performance of HSC	.262	.368	<0.01	*$H1_d$:* Accepted *$H0_d$:* Rejected

Source: Self-conducted survey, 2024

5. Conclusion and Recommendations

The findings underscore the critical role of standardization and leadership in enhancing humanitarian supply chain performance at ERCS. The study reveals that emphasizing standardized processes and strengthening leadership can significantly improve operational efficiency and responsiveness. In contrast, technological advancements and collaboration currently do not meaningfully impact humanitarian supply chain performance within ERCS. Future efforts should prioritize enhancing leadership capabilities and enforcing standardized procedures to optimize humanitarian operations effectively.

Based on these findings, the following recommendations are proposed to enhance humanitarian supply chain performance efficiency in aid delivery:

For ERCS: Implement and rigorously enforce standardized operating procedures across all supply chain operations to improve efficiency.

For Academia: Conduct comprehensive studies on specific aspects of standardization and leadership that directly influence humanitarian supply chain performance. Identify best practices applicable to similar organizations.

For Policymakers: Formulate policies that promote and facilitate the standardization of humanitarian supply chain processes within ERCS and other aid organizations in Ethiopia.

For Practitioners: Embrace and effectively utilize advanced technological tools (e.g., SCM software, ICT technology) to monitor, manage, and optimize supply chain operations towards ensuring timely and cost-effective aid delivery.

Moreover, future research should consider the following areas to address remaining gaps:

- Conduct longitudinal studies to assess the sustainability and long-term effectiveness of interventions aimed at improving supply chain reliability, responsiveness, flexibility, and cost-effectiveness.
- Complement quantitative analyses with qualitative investigations to gain deeper insights into contextual factors influencing humanitarian supply chain performance.

- Compare supply chain performance metrics across different sectors or organizations within the humanitarian aid landscape to identify transferable knowledge and best practices.
- Explore the impact of external factors such as political instability, economic fluctuations, and environmental hazards on supply chain resilience and effectiveness in humanitarian operations. Develop adaptive strategies and contingency plans based on these insights.

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