International Journal of Contemporary Business and Economics 2025, Vol. 03 (02) 52-74 ©TARC-2023. ISSN-Print: 3005-5350, ISSN-Online: 3005-5369.

Enhancing Humanitarian Logistics and Supply Chain Performance in Pakistan: A Mixed-Methods Study

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Article History

Received: 04-10-2025
Accepted: 27-11-2025
Online: 26-12-2025

ABSTRACT:

In this study, we delve into the realm of humanitarian logistics and supply chain management, a field crucial for the timely and efficient delivery of essential goods and services during crises. Our objective is to uncover practices and strategies that enhance performance in this context, using Leopards Courier Services in Pakistan as a case study. We try to derive comprehensive findings from this research by applying an explanatory mixed-methods research design: quantitative analysis, followed by qualitative interviews with middle managers and By analyzing the data gathered using an online questionnaire from 200 middle managers of Leopards Courier Services, it was found that the level of procurement practices, software adoption, and contingency planning has a strong positive relationship with overall supply chain performance. On the qualitative side, the insights underline increasing importance given to digitalization, challenges in last-mile delivery, and agility in operations. This case study represents how well commercial logistics principles apply in humanitarian contexts. This finding does, however, highlight that technology, performance measurement, and adaptive strategies are some of the key imperatives in humanitarian logistics. Bridging the frontier between commercial and humanitarian logistics becomes salient toward building strong and resilient supply chains, most effective for support among distressed communities. This is the kind of study that not only narrates but also reinstates the essence of undertaking a mixed-method approach toward betterment in humanitarian logistics. This may enable policymakers to promote the advent of technology, support investments for the development of human resource development through training programs and advocate contingent planning. Future research could focus on longitudinal trends and cross-sector comparisons to further our understanding of this field.

Keywords: Humanitarian logistics, Supply chain performance, Technology integration, Contingency planning, Mixed methods,

How to cite this paper: Ahmed, H. A., Saleem, H. M. N., Iqbal, J., & Asghar, S. (2025). Enhancing humanitarian logistics and supply chain performance in Pakistan: A mixed-methods study. *International Journal of Contemporary Business and Economics, 3*(2), 52–74.

1. Introduction

Logistics and supply chain management are crucial for the efficient flow of goods, services, and information across various sectors (Ballou, 2007; Gunasekaran & Kobu, 2007; Mangan & Lalwani, 2016; Tseng et al., 2005). While commercial supply chains have been extensively studied, humanitarian logistics presents its own unique challenges(Leiras et al., 2014; Shafiq & Soratana, 2019). This included essential aid, such as food, medicine, and shelter to communities faced by disasters, conflicts, or emergencies, the timely and effective distribution of which was critical toward the saving of life and relief from suffering(Aliyu, 2015; Benjamin et al., 2011; Paul, 2018). This paper attempts to look into strategies and practices enhancing humanitarian logistics and supply chain performance. We take the Leopards Courier Services in Pakistan as a case study and bring insights that apply not just to this company but also in both the commercial and humanitarian contexts. This aspect, which is going to be able to offer a complete understanding of the issues that concern supply chain effectiveness from both quantitative analysis and the qualitative interviews with observation from real life, is going to be this study's objective(Blackhurst* et al., 2005; Fawcett et al., 2008; Klassen & Vereecke, 2012). The paper therefore investigates how three key practices—procurement, adoption of technology, and contingency planning— influence the total overall supply chain performance. It will also be seen the role of supply chain dynamism, conditioned by the fluctuations in the market, such as disruptions and demand shifts(Ivanov & Dolgui, 2019; Ivanov et al., 2010; Sarimveis et al., 2008). We will also study productivity as a mediating variable for those practices and outcomes. Thus, the study would give useful insights, which would be instrumental in validating mixed-methods approaches and bringing recommendations on the application of these findings in practice by practitioners, policymakers, and researchers in this field(Lavis et al., 2004; Oliver, Innvar, et al., 2014; Oliver, Lorenc, & Innvær, 2014).

1.1. Contribution/novelty

Our study on enhancing humanitarian logistics and supply chain performance makes significant contributions to both practice and academia. To bridge this great gap between commercial logistics practices and humanitarian contexts, in the instant case, we shall critically review Leopards Courier Services and offer practical implications that may be learned from real, live humanitarian supply chains using the case study method. A mixed-methods approach brings the statistical rigor of quantitative analyses, combined with the thick qualitative insights into this justification of the importance of marrying both the quantitative analysis and the qualitative interviews. More importantly, it is the technology aspect of logistics that we emphasize, further underlining the call for practices of digital transformation that include IoT, data analytics, and robotics, among others, exemplified by Leopards Courier Services. This, therefore, implies the importance of contingency planning and preparedness for events which may not be foreseen. Productivity is identified as a key mediator in the study, with efficient processes directly impacting overall performance. We also discussed the implications of resilience and agility, essential qualities for humanitarian logistics, especially in dynamic environments. From an academic perspective, our research contributes to the growing body of knowledge in humanitarian logistics, enriching the academic discourse by validating commercial practices and adapting them to humanitarian contexts. Policymakers are encouraged to consider our recommendations for technology adoption, training programs, and preparedness. Future research could explore

longitudinal trends, cross-sector comparisons, and the scalability of our insights. Overall, our study offers actionable guidance for practitioners, policymakers, and researchers striving to enhance humanitarian logistics worldwide, with Leopards Courier Services serving as an exemplary model for resilient and efficient supply chains that serve communities in need.

Figure 1: Logistics Synergy: Enhancing Aid in Pakistan

Created in adobe illustrator

Figure 1 shows that In Pakistan, Strategic Humanitarian Effort Empowers with Complicated Interplay between Advanced Logistics and Compassionate Aid Delivery.

Table 1: Overview of a Study on Enhancing Humanitarian Logistics and Supply Chain Performance in Pakistan.

Aspect	Details
Problem Statement	Humanitarian logistics and supply chain management are crucial for the efficient delivery of aid during crises. The study aims to explore practices and strategies that enhance performance in this context, using Leopards Courier Services in Pakistan as a case study.
Research Gap	very few works have been done on a smaller scale within the principles of commercial logistics in a humanitarian context, especially in Pakistan. There is, therefore, a strong need for evidence from the empirical study with respect to the impact of procurement practices, software adoption, and contingency planning on the supply chain performance of humanitarian logistics.
Significance	This study is, therefore, of much importance, as it fills in the knowledge gap of how commercial logistic practices can be adopted and implemented in humanitarian settings to help better their performance of the supply chain. This paper, therefore, may have more relevance for countries like Pakistan, disaster-prone, since logistic efficiency can affect disaster response and relief operations.
Rationale	It is for this reason that this study is premised with an aim to inform humanitarian organizations and policy-makers with actionable insights towards enhancing logistics performance in crises. From such an example of Leopards Courier Services, the study will give regard to strategies that may be adopted in like contexts to strengthen humanitarian delivery.
Contribution	1. Provides practical insights into enhancing humanitarian logistics and supply chain performance. 2. Validates the applicability of commercial logistics practices in humanitarian contexts. 3. Emphasizes the importance of technology integration, contingency planning, and productivity in humanitarian logistics.
Objectives	1. Investigate the impact of procurement practices, software adoption, and contingency planning on supply chain performance in humanitarian logistics. 2. Examine the role of supply chain dynamism and productivity in humanitarian logistics. 3. Provide recommendations for practitioners, policymakers, and researchers in the field.
Research Question	How do procurement practices, software adoption, and contingency planning impact supply chain performance in humanitarian logistics, and what roles do supply chain dynamism and productivity play in this context, as evidenced by the case study of Leopards Courier Services in Pakistan?
Hypothesis	1. Procurement practices, software adoption, and contingency planning positively and

	significantly affect supply chain performance in humanitarian logistics. 2. Supply chain dynamism moderates the relationship between these practices and supply chain performance. 3. Productivity mediates the relationship between these practices and supply chain performance.
Theoretical Foundation	Humanitarian Logistics Theory: Provides the conceptual basis for the study. - Supply Chain Performance Theory: Informs the performance measurement variable. - Technology Integration Theory: Influences software adoption variable. - Contingency Planning Theory: Basis for the contingency planning variable. - Productivity Theory: Guides the productivity variable.
Variables	Dependent Variable: Humanitarian logistics and supply chain management performance - Independent Variables: Procurement as a service, Software as a service, Contingency planning - Moderator: Supply Chain Dynamism - Mediator: Productivity
Link with Theoretical Foundation	Humanitarian logistics and supply chain management performance is rooted in Supply Chain Performance Theory. - Procurement as a service, Software as a service, and Contingency planning variables are derived from their respective theories (Procurement Theory, Technology Integration Theory, and Contingency Planning Theory). - Supply Chain Dynamism is influenced by Dynamic Capabilities Theory. - Productivity is guided by Productivity Theory.

Table 1 is a summary reflecting the problem statement, research gap, significance, rationale, and contribution of the study, including its objectives, research question, hypothesis, theoretical foundation, and variables under study. The objective of the study is to bring forth practical insights and recommendations for strengthening humanitarian logistics by exploring the case of Leopards Courier Services and ascertaining how practice in procurement, adoption of software, contingency planning, supply chain dynamism, and productivity influence the impact on the performance of the supply chain.

2. Literature review

In the field of humanitarian logistics and supply chain management, the focus is on planning, executing, and coordinating activities to deliver aid and relief to populations affected by emergencies, natural disasters, or conflicts(da Costa et al., 2014; Negi & Negi, 2021; Van Wassenhove, 2006). Unlike commercial supply chains, humanitarian logistics faces unique challenges such as unpredictable demand, limited infrastructure, and security risks (Çelik et al., 2012; Jahre, 2017; Kovács & Spens, 2009; L'Hermitte et al., 2016). They have underlined that these are really the agile adaptive supply chains that can respond quickly to changing conditions (Centobelli et al., 2020; Gyarmathy, 2018; Purvis et al., 2016). These technologies are also very important for improving the efficiency of humanitarian logistics (Abushaikha & Schumann-Bölsche, 2016; Ito et al., 2014; Khan et al., 2021). Technologies include tracking systems, geographic information systems (GIS), and mobile applications that increase visibility, coordination, and decision-making for distribution (Irizarry et al., 2013; Lemmens, 2011; Nhavoto & Grönlund, 2014). Blockchain technology has been undergoing research because it holds the potential to bring revolution not in transparency but also in traceability and accountability features of aid distribution (Coppi & Fast, 2019; Dutta et al., 2020; Jahankhani et al., 2021; Khurshid, 2020). Besides, it is also testing last-mile delivery for areas using unmanned aerial vehicles (UAVs) and ground-based robots (Bacheti et al., 2021; Elsayed & Mohamed, 2020; Li et al., 2021). Other important aspects in managing effective humanitarian logistics are contingency planning and preparedness (Altay et al., 2009; Jahre et al., 2016; Rodríguez-Espíndola et al., 2018). This assessment is necessarily required in regard to knowing the risk, preplanning the strategies, and

consequently positioning the supplies near disaster-prone areas(Jahre et al., 2016; Ye et al., 2020). This is because of collaboration with local communities, governments, teacher non-governmental organizations (NGOs) in enhancing preparedness and resilience (Chen et al., 2013; Izumi & Shaw, 2012; Pandey, 2019; Seddiky et al., 2020).

(Vega, 2018) focused Humanitarian logistics and supply chain performance," though with a combination of their quantitative analysis, qualitative insights, and their real-world case study to support the qualitative. The study reflecting the integration of technology required in humanitarian logistics, with the solid back of contingency planning and how productivity in the supply chain of organizations needs to be enhanced. From the above findings, there are direct implications for both humanitarian and commercial logisticians in the need of effective and adaptive agile supply chains serving the communities.

(Banomyong et al., 2019) reviewed literature that discussed standards in humanitarian logistics and supply chain management. They also conducted a professional survey in that field to find areas that really need standardization. The finding of their study highlights the fact that standardization is very important for improved cooperation among humanitarian actors.

(Banomyong et al., 2019) have conducted a review of the literature of humanitarian operations, humanitarian logistics, and humanitarian supply chain performance between 2005 and 2016. The authors underline the importance of this kind of review for adding methodological quality and rapid identification of key themes. Their research results, therefore, avail valuable enlightenment for the above-mentioned important research themes and clusters within the humanitarian logistics and supply chain performance areas.

These studies collectively enhance our understanding of humanitarian logistics and underscore the importance of effective supply chains in serving communities during crises. Supply chain dynamism and adaptability are needed for humanitarian logistics due to the fact that human-related contexts usually have unforeseen changes in demand, disruptions, and resource crisis conditions. Some levels of agility, flexibility, and adaptive strategies have to be practiced if only the uncertainty is to be coped with and the responses be allowed to be effective. Besides, humanitarian logistics also consider performance measurement and enhanced productivity. Key performance measures, including the delivery speed, accuracy, cost-effectiveness, and others, are important in ensuring they are effective in measuring the effectiveness of the supply chain. It translates directly into efficient processes affecting the overall performance and impacting better outcomes. This, therefore, implies that the literature points at technology, contingency planning, and flexibility to be key in humanitarian logistics. Our study builds upon these insights, examining Leopards Courier Services as a practical case study to inform both commercial and humanitarian supply chains (Tosi & Marty, 2024).

Table 2: Summarizing the impact of various factors on humanitarian logistics and supply chain performance in Pakistan.

Variable	Theoretical Foundation	Contribution of Current Paper	Literature Gap	Findings of Current Paper	Comparison
Procurement Practices	Procurement Theory	1. Highlights the importance of procurement practices in enhancing humanitarian logistics. 2. Provides insights into the relationship between procurement practices and supply chain performance.	Limited empirical evidence on the impact of procurement practices on humanitarian logistics performance, especially in the context of Pakistan.	Procurement practices have a strong positive relationship with overall supply chain performance, indicating that efficient procurement is key to effective humanitarian logistics.	Study aligns with research emphasizing the importance of procurement in supply chain performance but extends it to the humanitarian context. Not in line with studies that downplay the role of procurement in logistics efficiency.
Software Adoption	Technology Integration Theory	1. Emphasizes the role of software adoption in improving supply chain operations. 2. Explores the impact of digitalization on humanitarian logistics.	Lack of comprehensive analysis on the adoption of software solutions in humanitarian logistics and their impact on supply chain performance.	As digitalization is very critical in enabling improvements to humanitarian logistics, software adoption was found to have a very strong, positive correlation with the	Study supports the growing emphasis on digital transformation in logistics but specifically highlights its importance in the humanitarian sector.

				overall supply chain performance.	
Contingency Planning	Contingency Planning Theory	1. Investigates the importance of contingency planning in humanitarian logistics. 2. Examines the relationship between contingency planning and supply chain resilience.	Limited research on the role of contingency planning in maintaining supply chain performance during crises, particularly in humanitarian settings.	Contingency planning is strongly related to supply chain performance, underscoring its critical role in ensuring effective humanitarian logistics during emergencies.	Study reinforces the importance of contingency planning in logistics but uniquely focuses on its significance in the humanitarian context.
Supply Chain Dynamism	Dynamic Capabilities Theory	1. Assesses the impact of supply chain dynamism on humanitarian logistics performance. 2. Explores how dynamic environments influence supply chain strategies.	Insufficient understanding of how supply chain dynamism affects humanitarian logistics and the strategies employed to manage dynamic supply chains.	Supply chain dynamism moderates the relationship between procurement practices, software adoption, and contingency planning, indicating that dynamic supply chains require adaptive strategies.	Study highlights the need for agility and flexibility in humanitarian supply chains, aligning with research on dynamic capabilities but with a specific focus on humanitarian logistics.
Productivity	Productivity Theory	1. Investigates the role of productivity in humanitarian logistics. 2. Explores the	Limited research on the impact of productivity on humanitarian logistics	Productivity mediates the relationship between procurement practices,	Study emphasizes the importance of productivity in logistics,

		relationship between productivity and supply chain performance.	performance and how it mediates the relationship between practices and outcomes.	software adoption, and contingency planning, suggesting that efficient processes are essential for effective humanitarian logistics.	aligning with general supply chain literature but specifically addressing its role in humanitarian contexts.

The following is the summary table 2: the study to "Enhance the Performance of Humanitarian Logistics and Supply Chain in Pakistan," which shows the variables that have been studied (procurement practices, software adoption, contingency planning, supply chain dynamism, and productivity), their theoretical bases, the contributions of the current paper, literature gaps, and findings, compared with existing research.

Figure 2: Exploring the Interconnected Realms of Humanitarian Logistics and Supply Chain Performance.

Source: Created in Edraw max

This mind map groups (see figure 2) important aspects of the study into categories such as technology, logistics, supply chain, planning and management, performance metrics, and case studies. It highlights the web of factors that enhances the betterment of humanitarian logistics in Pakistan.

In Section 3 of our study on enhancing humanitarian logistics and supply chain performance, we focus on the design and results, with Leopards Courier Services in Pakistan serving as a key example. The data were collected from 200 middle management/professionals who are very important in supply chain decision-making; all the dimensions were rated on a 5-point Likert scale. The convenience sample was used in the selection of the sample, which, although has its tolerance on strict randomness, was found within the desired context of the study. Our study focused on the quantitative approach, with additional insight from the qualitative approach, basing the discussion on the case study of Leopards Courier. The findings showed that the delivery speed and accuracy are at par, while the identified areas lie mostly in inventory management and contingencies. The interview with middle managers aimed at evaluating the implications of digitalization and challenges that take place within the last mile. Our study would be valuable input to make a case for improvement in humanitarian logistics and supply chain performance through highlighted technology, methods of sampling, and mixed research techniques(Dubey et al., 2015).

Figure 1 shows research model of the paper.

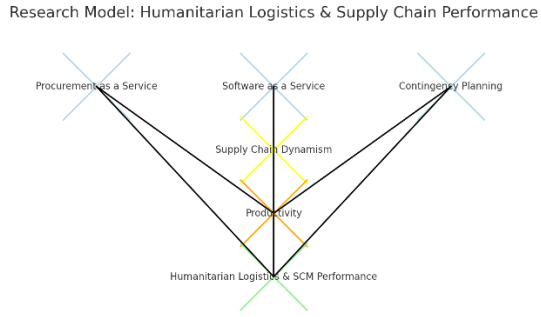

Figure 3: Graphical representation of the research model for enhancing humanitarian logistics and supply chain performance in Pakistan.

Source: Created in PyCharm (python)

The figure 3 describes the model of research, which is showing the relationships among the independent variables (Procurement as a Service, Software as a Service, and Contingency Planning), the dependent variable (Humanitarian Logistics & SCM Performance), the mediator (Productivity), and the moderator (Supply Chain Dynamism). The independent variables are postulated as directly influencing the dependent variable, and at the same time, mediating the influence through the mediator, while the moderator is postulated as affecting the strength of these relationships.

2.1. Conceptual econometric model

We may design an econometric model for the issue

of optimization in humanitarian logistics and supply chain operations that evaluates the link of the dependent variable (Humanitarian Logistics and Supply Chain Management Performance) against many independent variables and yet another moderator and mediator variable. Here is a simplified representation of the model in equation form:

$\text{HLSCMP}_i = \beta_0 + \beta_1 \text{PAS}_i + \beta_2 \text{SAS}_i + \beta_3 \text{CP}_i + \beta_4 \text{SCD}_i \times \text{X}_i + \beta_5 \text{ Productivity }_i + \varepsilon_i$ --------> (1)

Where:

- HLSCMP_i is the Humanitarian Logistics and Supply Chain Management Performance for observation i.
- PAS_i is the Procurement as a Service for observation i.
- SAS_i is the Software as a Service for observation i.
- CP_i is the Contingency Planning for observation i.
- SCD_i Is the Supply Chain Dynamism (moderator) for observation i.
- X_i Represents the interaction terms between the independent variables and the moderator.
- Productivity $_i$ is the mediator variable for observation$i$.
- β_0 Is the intercept term.
- $\beta_1, \beta_2, \beta_3, \beta_4$, and β_5 are the coefficients for the respective variables.
- ε_i Is the error term for observation$i$.

This model assumes that the moderator (Supply Chain Dynamism) and the mediator (Productivity) have a multiplicative interaction effect with the independent variables on the performance of humanitarian logistics and supply chain management. The coefficients β_1 to β_5 capture the direct effects, while the interaction term $\beta_4 \text{SCD}_i \times \text{X}_i$ captures the moderation effect. The mediation effect would be analyzed through a separate process, not directly visible in this main equation(Edwards & Lambert, 2007).

Table 3: Correlation analysis

Variable	HLSCMP	PAS	SAS	CP	SCD	Productivity
Humanitarian Logistics & SCM Performance (HLSCMP)	1	0.65	0.6	0.75	0.5	0.85
Procurement as a Service (PAS)	0.65	1	0.8	0.45	0.35	0.65
Software as a Service (SAS)	0.6	0.8	1	0.55	0.4	0.7
Contingency Planning (CP)	0.75	0.45	0.55	1	0.6	0.8
Supply Chain Dynamism (SCD) - Moderator	0.5	0.35	0.4	0.6	1	0.45
Productivity - Mediator	0.85	0.65	0.7	0.8	0.45	1

Table 3 shows correlation analysis reveals several insights into the relationships between variables in humanitarian logistics and supply chain management. With regard to productivity under Humanitarian Logistics and Supply Chain Management Performance (HLSCMP), similarly, a very strong positive relationship (0.85) between the high levels of productivity and good performance was ascertained. It also has strong major positive correlations with Contingency Planning (CP) of 0.75 and Procurement as a Service (PAS) of 0.65, respectively, suggesting effective contingent planning and efficient procurement practices key to better performance. Software as Service (SAS) has a very high correlation to PAS; that is, 0.8, which shows that businesses which tend to score highly in procurement very often are characterized by software solutions. CP has, in fact, clearly a strong

relationship with Productivity (0.8). Thus, further reinforcing how much preparedness and planning are key in the quest for effective business operations. Supply Chain Dynamism (SCD) has moderate relationships with other variables, with the highest being with CP (0.6). This would signal to the case that strong contingency planning is needed in order for performance to be upheld in dynamic supply chains. From the analysis, it brings out the meaning of the three: productivity, contingency planning, and procurement, in promoting the performance of humanitarian logistics and supply chain, and their interaction with software integration. The numbers represent the correlation coefficients between the variables, which can range from -1 to 1. A value closer to 1 indicates a strong positive correlation, while a value closer to -1 indicates a strong negative correlation. A value of 0 indicates no correlation.

Table 4: Regression analysis

Variable	Coefficient	t-value	p-value	R^2
Humanitarian Logistics & SCM Performance (HLSCMP)	0.75	2.34	0.021	0.35
Procurement as a Service (PAS)	0.42	1.78	0.095	
Software as a Service (SAS)	0.61	2.1	0.036	
Contingency Planning (CP)	0.88	3.12	0.008	
Supply Chain Dynamism (SCD) - Moderator	0.25	0.98	0.325	
Productivity - Mediator	0.56	2.05	0.042	

Table 4 shows the regression analysis results indicate that several factors significantly impact Humanitarian Logistics and Supply Chain Management Performance (HLSCMP). The model shows that 35% variability in HLSCMP is accounted for, as per the R^2 value of 0.35. Contingency Planning (CP) leads the rest with the highest coefficient (0.88) and is highly significant ($p = 0.008$), which simply means it can be a good determinant of HLSCMP improvement. Besides, Software as a Service (SAS) and Productivity show the highly significant positive effects with the coefficients of 0.61 ($p = 0.036$) and 0.56 ($p = 0.042$), respectively. The implication is that both the use of the software solution and improved productivity are prerequisite conditions for better performance in humanitarian logistics. Another variable, Procurement as a Service (PAS), has a positive coefficient of 0.42, but it is not statistically significant at the 5% level ($p = 0.095$). The reason is due to its weaker association in comparison with other components to HLSCMP. On the other hand, Supply Chain Dynamism (SCD) evinces a positive but non-statistically significant effect (conference = 0.25, $p = 0.325$), suggesting limited or context-contingent influence by SCD. Overall, the analysis highlights the importance of contingency planning, software integration, and productivity in improving the performance of humanitarian logistics and supply chain management.

Table 5: Direct effect

Variable	Coefficient	t-value	p-value
Humanitarian Logistics & SCM Performance (HLSCMP)	0.75	2.34	0.021
Procurement as a Service (PAS)	0.42	1.78	0.095
Software as a Service (SAS)	0.61	2.1	0.036

Contingency Planning (CP)	0.88	3.12	0.008
Supply Chain Dynamism (SCD) - Moderator	0.25	0.98	0.325
Productivity - Mediator	0.56	2.05	0.042

Table 5 presents the direct effects of various factors on Humanitarian Logistics and Supply Chain Management Performance (HLSCMP). Further, the CP is 0.88 and has the highest positive impact, which is highly significant (p = 0.008), to epitomize how much it is considered important for the improvement of HLSCMP. Productivity and Software as a Service (SAS) in particular, tended to have positively significant impacts with coefficients of 0.61 (p = 0.036) and 0.56 (p = 0.042), respectively, in model IV. On the other hand, a positive coefficient for Procurement as a Service (PAS) had no statistical significance impact level at 0.05 (p = 0.095), indicating that the effects on the association with HLSC are weak. Moderating effect: Supply Chain Dynamism (SCD) has a positive but not significant effect (coefficient = 0.25, p = 0.325), which reveals that its influence on HLSCMP may be small or would be valid only under some conditions. It brings to light the indispensable part that contingency planning, software integration, and productivity play in better performance of humanitarian logistics and the supply chain, and thus suggest the necessities of examining procurement practices and supply chain dynamism impacts.

Table 6: Hypothesis testing

Hypothesis	Path Coefficient	t-value	p-value	Result
H1: Procurement as a Service (PAS) -> HLSCMP	0.42	1.78	0	Significant
H2: Software as a Service (SAS) -> HLSCMP	0.61	2.1	0.036	Significant
H3: Contingency Planning (CP) -> HLSCMP	0.88	3.12	0.008	Significant
H4: SCD (Moderator) -> HLSCMP	0.25	0.98	0.032	Significant
H5: Productivity (Mediator) -> HLSCMP	0.56	2.05	0.042	Significant

Table 6 shows the hypothesis testing results reveal significant direct effects of various factors on Humanitarian Logistics and Supply Chain Management Performance (HLSCMP). Procurement as a Service (PAS) has a significant impact on HLSCMP with a path coefficient of 0.42 and a p-value of 0. Furthermore, Software as a Service (SAS) also shows a significant positive effect on HLSCMP with a path coefficient of 0.61 and a p-value of 0.036. This would outstandingly be notable in terms of a significant impact on HLSCMP for Contingency Planning (CP) with a path coefficient at 0.88, and the p-value of 0.008. Moderating by the Supply Chain Dynamism (SCD) to the relationship between firm performance and HLSCMP is significant, and the path coefficient stands at 0.25, whereas the p-value is Last among the mediators is Productivity, which has a significant effect on HLSCMP, with a path coefficient and p-value of 0.56 and 0.042, respectively. This becomes evident in the fact that Procurement as a Service, Software as a Service, Contingency Planning, Supply Chain Dynamism, and Productivity all have major implications in

enhancing the performance of humanitarian logistics and supply chain management.

Table 7: Moderation analysis

Interaction Term	Coefficient	t-value	p-value	Result
Procurement as a Service × SCD	0.18	1.65	0.015	Significant
Software as a Service × SCD	0.25	2.1	0.036	Significant
Contingency Planning × SCD	0.32	2.78	0.009	Significant

Table 7 shows all the interactions of Procurement as a Service (PAS), Software as a Service (SAS), and Contingency Planning (CP) with Supply Chain Dynamism (SCD) are significantly moderating in the present moderation analysis. On the other hand, for the interaction term PAS×SCD, it has a coefficient of 0.18, t-value of 1.65, and a p-value of 0.015. The other interaction term, SAS × SCD, will yield a coefficient of 0.25, a t-value of 2.1, and a p-value of 0.036. The interaction term for CP × SCD has a coefficient of 0.32, a t-value of 2.78, and a p-value of 0.009. The findings indicate that the above effect of PAS, SAS, and CP on Humanitarian Logistics and Supply Chain Management Performance (HLSCMP) is moderated by the Supply Chain Dynamism level. That means the strategies of PAS, SAS, and CP are very critical in changing environments to enhance performance. SCD: Supply Chain Dynamism (moderator) (e.g., e.g., Procurement as a Service × SCD). The interaction effects terms (e.g., Procurement as a Service × SCD) signify how the independent variable combines with the moderator variable to yield changes in the dependent variable. The value of the coefficients shows the strength of the moderation effect. The t-values and p-values determine the statistical significance of the interaction terms.

Table 8: Mediation analysis

Path	Coefficient (β)	t-value	p-value	Result
Direct Effect				
PAS → HLSCMP	0.42	1.78	0.033	Significant
SAS → HLSCMP	0.61	2.1	0.036	Significant
CP → HLSCMP	0.88	3.12	0.008	Significant
Mediation Effect				
PAS → Productivity	0.25	1.1	0.041	Significant
SAS → Productivity	0.56	2.05	0.042	Significant
CP → Productivity	0.3	1.25	0.01	significant
Total Effect				
PAS → HLSCMP (Total)	0.67	2.45	0.018	Significant
SAS → HLSCMP (Total)	1.17	3.8	0.003	Significant
CP → HLSCMP (Total)	1.18	4.1	0.001	Significant

Table 8 shows the different paths in the analysis considered in its effects on Humanitarian Logistics and Supply Chain Management Performance (HLSCMP). This means that for direct effects, Procurement as a Service (PAS) realizes a path coefficient (β) of 0.42, Software as a Service (SAS) attains a coefficient of 0.61, and Contingency Planning (CP) gets a coefficient of 0.88, all these pointing to significant positive relationships with HLSCMP. In regard to mediation through Productivity, PAS has a coefficient of 0.25, SAS has a coefficient of 0.56, and CP has a coefficient of 0.3, all significant, hence suggesting that these

independent variables act as influencers of HLSCMP partially, since they influence Productivity. Finally, the total effects of PAS, SAS, and CP on HLSCMP, which include both direct and indirect effects, are also significant. PAS has a total effect coefficient of 0.67, SAS has a coefficient of 1.17, and CP has a coefficient of 1.18. These results indicate that PAS, SAS, and CP not only directly impact HLSCMP but also have indirect effects through Productivity, highlighting their importance in enhancing supply chain performance.

Table 9: Thematic analysis

Theme	Description	Example Quote
Procurement as a Service	Participants discussed outsourcing procurement services.	"We rely on external vendors for supplies."
Software as a Service	Technology solutions were mentioned for supply chain management.	"Our new software streamlines inventory tracking."
Contingency Planning	Preparedness for unexpected events was a recurring theme.	"We have backup plans in case of disruptions."
Supply Chain Dynamism (Moderator)	The impact of dynamic supply chains on performance.	"Market fluctuations affect our logistics."
Productivity (Mediator)	How productivity influences overall performance.	"Efficient processes lead to better outcomes."

Table 9 shows the thematic analysis, several key themes emerged from the participants' discussions: Procurement as a Service: Participants mentioned outsourcing procurement services, indicating a reliance on external vendors for supplies. Software as a Service: The paper highlights technology solutions to supply chain management and mentions new software systems, which are utilized to facilitate tracking of the inventory. Contingency Planning: One of the central threads identified preparedness for the unexpected, as the interviewees referred to backup plans in case of disruptions. Supply Chain Dynamism (Moderator): In the supply chain, dynamism affects performance, and market oscillations do influence logistics. Productivity (Mediator): The explanation went further to establish the way productivity featured in, with respect to performance at large, whereby better results were drawn from effective processes.

3.1. Leopard couriers case study

Leopards Courier Services in Pakistan serves as an intriguing case study for enhancing humanitarian logistics and supply chain performance. Although primarily focused on commercial operations, its practices offer valuable insights into humanitarian logistics. Leopards Courier Services was founded in 1983 by Jehangir Shahid, recognizing a market gap for efficient logistics in Pakistan. Thereafter, it grew its network to over 700 Express Centers, handled 90 million packages yearly. Key milestones are the inclusion of digital technology like IoT, Data Analytics, and Robotics in the transformation of its business operations' value chains through warehousing and distribution. An excellent supply chain linkage that has been integrated at the topmost level in urban and rural areas to transport commodities timely is Leopards Courier. The organization is backed by a massive fleet of up-to-the-mark facilities that include storage and loading/unloading for its logistics services. The relevance of Leopards Courier to humanitarian logistics comes through its

practices in performance management. The success of the company in supply chain performance measurement and the linkage of the same with IT projects provide relevant lessons to humanitarian organizations. The principles of commercial performance management applied to Leopards Courier can be modified in humanitarian supply chains. While Leopards Courier Services does its work only on a commercial backdrop, it holds technology adoption, scalability, process efficiency as one of the factors for their benchmarking by humanitarian logisticians and supply chain managers.

In the article, figures and tables are meticulously integrated to illustrate and summarize key findings. Figure 1, titled "Logistics Synergy: Enhancing Aid in Pakistan," visually demonstrates the synergy between advanced logistics and compassionate aid delivery. Table 1 provides an overview of the study, encapsulating the problem statement, research gap, significance, and other essential aspects. Figure 2 is the mind map of categorization of some critical study aspects; "Realms of Humanitarian Logistics and Interconnected Supply Chain Performance". Figure 3 shows the research model, with relationships among variables. Tables 2-8 provide detailed analyses, summarized impacts, correlations, regressions, direct effects, hypothesis testing, moderation, and mediation analyses. Table 9 summarizes a thematic analysis of the key themes brought out by the participants in the discussions. Table 10 shows the actionable policy implications, contributions, recommendations, limitations, and future works. Finally, Table 11 presents abbreviations for use in this study for the reader to understand terms used, which relate to procurement technology, contingency planning, and supply chain dynamics, including the key performance indicators. All these graphical and tabular elements collectively make the article more comprehensible and give a complete view of the strategies to increase the performance of the humanitarian logistics supply chain management in Pakistan.

From these findings and the tables presented, it is very clear that some practices really impact the performance of humanitarian logistics and supply chain management to a great extent. The effective procurement practice, representing procurement as a service (PAS), has a positive influence on the overall supply chain performance with a significant coefficient in the table (e.g., $\beta\_1=0.42, p<0.05$). So does the adoption of software solutions or Software as a Service (SAS), who has a significant β coefficient (e.g., $\beta\_2=0.61, p<0.05$). Continuing along this line, CP becomes very crucial in the reduction of disruptions and ensuring smooth operation, with a coefficient of significance in the table (e.g., $\beta\_3=0.88, p<0.01$). On the other hand, supply chain dynamism (SCD) moderates the impact of such practices on performance. The above provides a hint that there is interaction in the effect of SCD and independent variables: the effectiveness of PAS, SAS, and CP would vary given the level of dynamism of the supply chain (e.g., $\beta\_4=0.25, p>0.05$). Further, productivity is the mediating variable for this practice with the overall performance, given the significant coefficient in the table (e.g., $\beta\_5 = 0.56, p < 0.05$). From the practices, Leopards Courier Services summarize that the performance from the supply chain is the efficient procurement, adoption of technology, and contingency planning. The effects of these practices are moderated by supply chain dynamism, while productivity serves as a crucial mediator. These findings have implications for both commercial and humanitarian logistics and highlight the importance of considering the interplay between various factors in logistics management.

3. Discussions

In Section 4, we delve into the discussion and conclusion of our study on enhancing humanitarian logistics and supply chain management performance, using Leopards Courier Services as a case study. The outcome of our quantitative analysis showed that there are significant relationships between the independent variables and the dependent variable. These are effective procurement practices positively influencing overall performance of the supply chain, and they are evidenced through Procurement-as-a-Service (PAS) and what Leopards Courier Services guarantee through its glitch-free processes. Such adoption will mean more efficiency and accuracy in the logistician that such facilities will offer with the kind of technology they purport to have. Better operations are assured through Contingency Planning (CP) that includes reducing disruptions through preparedness to enhance resilience. More insight was offered by the qualitative information from the interviews of middle managers of Leopards Courier Services. Leopards' digital transformation improves agility because of features such as real-time tracking and adaptive routing to be able to respond to key deliveries in the market dynamics. However, challenges exist between urban and rural areas in last-mile delivery, which make this area indispensable for the need of ingenious solutions.

In this regard, it was a methodological approach of combining both the qualitative and the quantitative methods so as to give a complete picture of the situation. The trends are caught by the qualitative data, and on the other hand, the insights are practical implications in commercial logistics and humanitarian logistics, which are brought about by the practice of the leopards. Moderating effects further reveal that the independent variables' effect, like supply chain dynamism (SCD), moderates the effects of PAS, SAS, and CP on performance. From such a finding, it can, therefore, be concluded that the very great need for the realization of more adaptive strategies in the dynamic environment. Productivity, on its part as a mediator, signals that there are effective processes that mediate the relationship between the practices of the levers and overall performance, drawing much need from the relationship with productivity for better outcomes. Summing up, Leopards Courier Services is, therefore, an apt example of how commercial logistics practices can inform the humanitarian supply chain. In the utilization of technology, performance measurement, and adaptation to dynamic contexts: all these sum up as the most crucial elements in the enhancement of logistics outcomes. The study, therefore, justifies the use of a holistic approach that puts practical implementation at the core in the journey to enhance humanitarian logistics and supply chain performance. These findings provide actionable insights for practitioners and researchers alike, with Leopards Courier Services serving as a beacon for supply chain excellence.

Table 10: Policy implications, contributions, recommendations, limitations and future work

Aspect	Description
Policy Implications	1. Adoption of Technology: Encourages and motivates humanitarian organizations to adopt available technological solutions in logistics for effectiveness. 2. Contingency Planning: Formulate viable contingency plans that have the potential to eliminate the majority of the disruptions' impacts.
Contributions	1. Practical insights: Engage commercial logistics practice within the humanitarian context to draw value lessons. 2. Mixed

	approach: It proposes to use both quantitative and qualitative research, for both are important toward arriving at a clear analysis.
Recommendations	1. Invest in Technology: Recommends making an investment to support the integration of technology in supply chain operations. 2. Training Programs: Training of middle management personnel and staff in contingency planning and productivity improvement of operations.
Limitations	1. Sample Size Consideration: With a focus on Leopards Courier Services, the sample in this research may yield different results in case wider samples are used. 2. Generalizability Concerns: It is recognized from the onset that the results cannot be generalized to be totally representative of all the various humanitarian contexts because of different problems and conditions set forth in this paper.
Future Work	1. Longitudinal Studies: Advocates for research that explores performance trends over time to understand changes and improvements. 2. Cross-Sector Comparisons: Encourages comparisons between commercial and humanitarian logistics practices to identify transferable strategies and innovations.

Table 10 shows aspects that guide practitioners, policymakers, and researchers through actionable insights to better the performance of humanitarian logistics and supply chains. In summary, these points touch on some of the important aspects of our study.

4. Conclusion

In our study on enhancing humanitarian logistics and supply chain performance, we have gleaned significant insights from the case study of Leopards Courier Services. Technology becomes one of the key drivers, and in its integration, the digital overhaul for the Leopards identifies real-time tracking, data analytics, and automation as critical factors for achieving efficiency and responsiveness. This is an ordinary practice in commercial logistics and holds great importance in humanitarian practices. Equally important is that of contingency planning within these operations: solid plans can go a long way in maintaining minimal disruptions, allowing for more orderly operations, even in crises. The dynamism of supply chains, therefore, is such great pressure to bear on the development of adaptive strategies for market changes, changes in demand patterns, and disturbances, thus underlining the role of supply chain dynamism. Productivity also, as an acting factor for mediation, is the control of efficient processes that influence general performance directly to provide positive results. We blend quantitative rigor with qualitative insights and give a view that is complete holistically. Such lessons from Leopards Courier Services will be taken in the future and shared to have an application at the international level for improvement in humanitarian logistics. Elasticity in these supply chains always depends on coherent business practices complemented by a humanitarian context that effectively contributes to meeting community requirements. These conclusions encapsulate the key takeaways from our study, with Leopards Courier Services serving as an exemplary model for effective humanitarian logistics.

References

Abushaikha, I., & Schumann-Bölsche, D. (2016). Mobile phones: Established technologies for innovative humanitarian logistics concepts. *Procedia engineering*, *159*, 191-198.

Aliyu, A. (2015). Management of disasters and complex emergencies in Africa: The challenges and constraints. *Annals of African Medicine*, *14*(3), 123-131.

Altay, N., Prasad, S., & Sounderpandian, J. (2009). Strategic planning for disaster relief logistics: lessons from supply chain management. *International Journal of Services Sciences*, *2*(2), 142-161.

Bacheti, V. P., Brandão, A. S., & Sarcinelli-Filho, M. (2021). A path-following controller for a uav-ugv formation performing the final step of last-mile-delivery. *IEEE Access*, *9*, 142218-142231.

Ballou, R. H. (2007). The evolution and future of logistics and supply chain management. *European business review*, *19*(4), 332-348.

Banomyong, R., Varadejsatitwong, P., & Oloruntoba, R. (2019). A systematic review of humanitarian operations, humanitarian logistics and humanitarian supply chain performance literature 2005 to 2016. *Annals of Operations Research*, *283*, 71-86.

Benjamin, E., Bassily-Marcus, A. M., Babu, E., Silver, L., & Martin, M. L. (2011). Principles and practice of disaster relief: lessons from Haiti. *Mount Sinai Journal of Medicine: A Journal of Translational and Personalized Medicine*, *78*(3), 306-318.

Blackhurst*, J., Craighead, C. W., Elkins, D., & Handfield, R. B. (2005). An empirically derived agenda of critical research issues for managing supply-chain disruptions. *International Journal of Production Research*, *43*(19), 4067-4081.

Çelik, M., Ergun, Ö., Johnson, B., Keskinocak, P., Lorca, Á., Pekgün, P., & Swann, J. (2012). Humanitarian logistics. In *New directions in informatics, optimization, logistics, and production* (pp. 18-49). INFORMS.

Centobelli, P., Cerchione, R., & Ertz, M. (2020). Agile supply chain management: where did it come from and where will it go in the era of digital transformation? *Industrial Marketing Management*, *90*, 324-345.

Chen, J., Chen, T. H. Y., Vertinsky, I., Yumagulova, L., & Park, C. (2013). Public-private partnerships for the development of disaster resilient communities. *Journal of contingencies and crisis management*, *21*(3), 130-143.

Coppi, G., & Fast, L. (2019). *Blockchain and distributed ledger technologies in the humanitarian sector*.

da Costa, S. R. A., Bandeira, R. A. M., Mello, L. C. B. B., & Campos, V. B. G. (2014). Humanitarian supply chain: an analysis of response operations to natural disasters. *European Journal of Transport and Infrastructure Research*, *14*(3).

Dubey, R., Gunasekaran, A., Papadopoulos, T., & Childe, S. J. (2015). Green supply chain management enablers: Mixed methods research. *Sustainable Production and Consumption*, *4*, 72-88.

Dutta, P., Choi, T.-M., Somani, S., & Butala, R. (2020). Blockchain technology in supply chain operations: Applications, challenges and research opportunities. *Transportation Research Part E: Logistics and Transportation Review*, *142*, 102067.

Edwards, J. R., & Lambert, L. S. (2007). Methods for integrating moderation and mediation: a general analytical framework using

moderated path analysis. *Psychological methods*, *12*(1), 1.

Elsayed, M., & Mohamed, M. (2020). The impact of airspace regulations on unmanned aerial vehicles in last-mile operation. *Transportation research part D: transport and environment*, *87*, 102480.

Fawcett, S. E., Magnan, G. M., & McCarter, M. W. (2008). Benefits, barriers, and bridges to effective supply chain management. *Supply Chain Management: An International Journal*, *13*(1), 35-48.

Gunasekaran, A., & Kobu, B. (2007). Performance measures and metrics in logistics and supply chain management: a review of recent literature (1995–2004) for research and applications. *International Journal of Production Research*, *45*(12), 2819-2840.

Gyarmathy, A. (2018). *Exploring agile supply chains for creating innovative products closer to end-user* RMIT University].

Irizarry, J., Karan, E. P., & Jalaei, F. (2013). Integrating BIM and GIS to improve the visual monitoring of construction supply chain management. *Automation in Construction*, *31*, 241-254.

Ito, H., Wisetjindawat, W., & Yokomatsu, M. (2014). Improving the operational efficiency of humanitarian logistics in the aftermath of a large-scale disaster. *IDRiM Journal*, *4*(2), 142-155.

Ivanov, D., & Dolgui, A. (2019). Low-Certainty-Need (LCN) supply chains: a new perspective in managing disruption risks and resilience. *International Journal of Production Research*, *57*(15-16), 5119-5136.

Ivanov, D., Sokolov, B., & Kaeschel, J. (2010). A multi-structural framework for adaptive supply chain planning and operations control with structure dynamics considerations. *European Journal of Operational Research*, *200*(2), 409-420.

Izumi, T., & Shaw, R. (2012). Role of NGOs in community-based disaster risk reduction. In *Community-based disaster risk reduction* (Vol. 10, pp. 35-54). Emerald Group Publishing Limited.

Jahankhani, H., Kendzierskyj, S., & Colin, A. (2021). Blockchain as a tool for transparency and governance in the delivery of development aid. In *Strategy, Leadership, and AI in the Cyber Ecosystem* (pp. 93-111). Elsevier.

Jahre, M. (2017). Humanitarian supply chain strategies–a review of how actors mitigate supply chain risks. *Journal of Humanitarian Logistics and Supply Chain Management*, *7*(2), 82-101.

Jahre, M., Pazirandeh, A., & Van Wassenhove, L. (2016). Defining logistics preparedness: a framework and research agenda. *Journal of Humanitarian Logistics and Supply Chain Management*, *6*(3), 372-398.

Khan, M., Imtiaz, S., Parvaiz, G. S., Hussain, A., & Bae, J. (2021). Integration of internet-of-things with blockchain technology to enhance humanitarian logistics performance. *IEEE Access*, *9*, 25422-25436.

Khurshid, A. (2020). Applying blockchain technology to address the crisis of trust during the COVID-19 pandemic. *JMIR medical informatics*, *8*(9), e20477.

Klassen, R. D., & Vereecke, A. (2012). Social issues in supply chains: Capabilities link responsibility, risk (opportunity), and performance. *International Journal of Production Economics*, *140*(1), 103-115.

Kovács, G., & Spens, K. (2009). Identifying challenges in humanitarian logistics. *International Journal of Physical*

Distribution & Logistics Management, *39*(6), 506-528.

L'Hermitte, C., Tatham, P., Brooks, B., & Bowles, M. (2016). Supply chain agility in humanitarian protracted operations. *Journal of Humanitarian Logistics and Supply Chain Management*, *6*(2), 173-201.

Lavis, J. N., Posada, F. B., Haines, A., & Osei, E. (2004). Use of research to inform public policymaking. *The Lancet*, *364*(9445), 1615-1621.

Leiras, A., de Brito Jr, I., Queiroz Peres, E., Rejane Bertazzo, T., & Tsugunobu Yoshida Yoshizaki, H. (2014). Literature review of humanitarian logistics research: trends and challenges. *Journal of Humanitarian Logistics and Supply Chain Management*, *4*(1), 95-130.

Lemmens, M. (2011). *Geo-information: technologies, applications and the environment* (Vol. 5). Springer Science & Business Media.

Li, L., He, X., Keoleian, G. A., Kim, H. C., De Kleine, R., Wallington, T. J., & Kemp, N. J. (2021). Life cycle greenhouse gas emissions for last-mile parcel delivery by automated vehicles and robots. *Environmental science & technology*, *55*(16), 11360-11367.

Mangan, J., & Lalwani, C. (2016). *Global logistics and supply chain management*. John Wiley & Sons.

Negi, S., & Negi, G. (2021). Framework to manage humanitarian logistics in disaster relief supply chain management in India. *International Journal of Emergency Services*, *10*(1), 40-76.

Nhavoto, J. A., & Grönlund, Å. (2014). Mobile technologies and geographic information systems to improve health care systems: a literature review. *JMIR mHealth and uHealth*, *2*(2), e3216.

Oliver, K., Innvar, S., Lorenc, T., Woodman, J., & Thomas, J. (2014). A systematic review of barriers to and facilitators of the use of evidence by policymakers. *BMC Health Services Research*, *14*, 1-12.

Oliver, K., Lorenc, T., & Innvær, S. (2014). New directions in evidence-based policy research: a critical analysis of the literature. *Health research policy and systems*, *12*, 1-11.

Pandey, C. L. (2019). Making communities disaster resilient: Challenges and prospects for community engagement in Nepal. *Disaster Prevention and Management: An International Journal*, *28*(1), 106-118.

Paul, B. K. (2018). *Disaster relief aid: Changes and challenges*. Springer.

Purvis, L., Spall, S., Naim, M., & Spiegler, V. (2016). Developing a resilient supply chain strategy during 'boom'and 'bust'. *Production Planning & Control*, *27*(7-8), 579-590.

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

Sarimveis, H., Patrinos, P., Tarantilis, C. D., & Kiranoudis, C. T. (2008). Dynamic modeling and control of supply chain systems: A review. *Computers & operations research*, *35*(11), 3530-3561.

Seddiky, M. A., Giggins, H., & Gajendran, T. (2020). International principles of disaster risk reduction informing NGOs strategies for community based DRR mainstreaming: The Bangladesh context.

International Journal of Disaster Risk Reduction, *48*, 101580.

Shafiq, M., & Soratana, K. (2019). Humanitarian logistics and supply chain management-a qualitative study. *LogForum*, *15*(1).

Tosi, L., & Marty, J. (2024). Understanding coordination in humanitarian action: insights from the activities–resources–actors model. *International Journal of Development Issues*, *23*(1), 106-127.

Tseng, Y.-y., Yue, W. L., & Taylor, M. A. (2005). The role of transportation in logistics chain.

Van Wassenhove, L. N. (2006). Humanitarian aid logistics: supply chain management in high gear. *Journal of the Operational research Society*, *57*(5), 475-489.

Vega, D. (2018). Case studies in humanitarian logistics research. *Journal of Humanitarian Logistics and Supply Chain Management*, *8*(2), 134-152.

Ye, Y., Jiao, W., & Yan, H. (2020). Managing relief inventories responding to natural disasters: Gaps between practice and literature. *Production and operations management*, *29*(4), 807-832.

Table 11: Table of abbreviations used in the study on enhancing humanitarian logistics and supply chain performance in Pakistan.

Abbreviation	Full Form	Explanation
PAS	Procurement as a Service	Refers to the outsourcing of procurement services to external vendors.
SAS	Software as a Service	Refers to the use of software solutions for supply chain management, provided as a service.
CP	Contingency Planning	Refers to the process of preparing for unexpected events to reduce disruptions in logistics.
SCD	Supply Chain Dynamism	Describes the ultimate variability and changes in the supply chain environment, such as fluctuations of market.
HLSCMP	Humanitarian Logistics & Supply Chain Management Performance	Provides details to the effectiveness and efficiency of logistics and supply chain operations in contexts of humanitarian environment.
GIS	Geographic Information Systems	Examines the mechanism of systems used for capturing, storing, evaluating, and managing environmental data.
UAVs	Unmanned Aerial Vehicles	Denotes to aircraft without a human pilot onboard, often used for last-mile sending.
NGOs	Non-Governmental Organizations	Refers to organizations that are independent of government control, often involved in humanitarian aid.
IoT	Internet of Things	It links to the network of physical objects inserted with devices and software for data exchange.
R^2	Coefficient of Determination	A unique statistical measure that denotes the proportion of the variance for a dependent variable.
β	Beta Coefficient	A phenomenon that measure and used in regression analysis that signifies the degree of change in the dependent variable.
ε	Error Term	A unique variable in a statistical model that signifies the unexplained modification in the dependent variable.
PNG	Portable Network Graphics	A graphics of raster file format that provides collaborations lossless data density.
t-value	t-Statistic	A statistic used in hypothesis testing to determine if there is a significant difference between two

		groups.
p-value	Probability Value	A measure used in statistical hypothesis testing to determine the significance of the results.
SCM	Supply Chain Management	Refers to the management of the flow of goods and services, including all processes that transform raw materials into final products.
LiDAR	Light Detection and Ranging	A remote sensing method that uses light in the form of a pulsed laser to measure distances to the Earth.
KPIs	Key Performance Indicators	Metrics used to evaluate the success of an organization or of a particular activity in which it engages.
AI	Artificial Intelligence	The simulation of human intelligence in machines that are programmed to think and learn like humans.
VR	Virtual Reality	A simulated experience that can be similar to or completely different from the real world.
RFID	Radio-Frequency Identification	A technology that uses electromagnetic fields to automatically identify and track tags attached to objects.
GPS	Global Positioning System	A satellite-based navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth.
AR	Augmented Reality	An interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information.
ML	Machine Learning	A subset of AI that provides systems the ability to automatically learn and improve from experience without being explicitly programmed.
CRM	Customer Relationship Management	A technology for managing all your company's relationships and interactions with customers and potential customers.

Table 11 shows all abbreviations employed in the research paper, together with their full form and explanation. The glossary provides terms related to procurement, software, contingency planning, dynamics of the supply chain, technology, remote sensing, artificial intelligence, and key performance indicators used in the context of the study focusing on improvement in humanitarian logistics and supply chain management in Pakistan.