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Enhancing Coordination and Decision Making in Humanitarian Logistics Through Artificial Intelligence: A Grounded Theory Approach

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Abstract

Background: The adoption of artificial intelligence (AI) in humanitarian logistics is essential for improving coordination and decision making, especially in the challenging landscape of disaster-relief settings. However, the current literature offers limited empirical evidence with respect to the specific impact of AI on coordination and decision making for real-life humanitarian problems. Based on evidence from the humanitarian sector, this paper focuses on how AI could help humanitarian organizations collaborate better, streamline relief supply-chain operations and use resources more effectively. *Methods:* Twelve key themes influencing AI integration are identified by the study using a Grounded Theory (GT) approach based on interviews with experts from the humanitarian sector. These themes include data reliability, operational limitations, ethical considerations and cultural sensitivities, among others. *Results:* The findings suggest that AI improves forecasting, planning and inter-organizational coordination and is especially useful during the preparedness and mitigation stages of relief operations. Successful adoption, however, depends on adjusting tools to actual field conditions, building trust and training and striking a balance between algorithmic support and human expertise. *Conclusions:* The paper offers useful and practical advice for humanitarian organizations looking to use AI technologies in an ethical way while taking into account workforce capabilities, cross-agency cooperation and field-level realities.

Keywords: humanitarian logistics; artificial intelligence; decision making; coordination; disaster response; emergency management; resource optimization; supply chain operations; grounded theory

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1. Introduction

Humanitarian logistics encompasses the entire chain of getting the right resources, like food, medicine, water or shelter, from donors to people in urgent need, typically under crisis conditions. The humanitarian logistics processes span needs assessment, sourcing, transportation, safe storage and, ultimately, last-mile distribution. Recent evidence shows that digital tools, from mobile apps to blockchain, can further enhance the speed, fairness and safety of these operations by improving real-time visibility and allocation decisions [1]. At the same time, humanitarian supply chains behave as complex adaptive systems in which countless actors (such as governments, NGOs, private firms and international agencies) interact in non-linear, often emergent ways. Therefore, standardized "best practices" need constant adaptation to local contexts [2].

The increasing frequency and severity of natural and human-induced disasters have garnered global attention toward humanitarian logistics. Providing prompt and coordinated assistance has become increasingly essential as humanitarian demands escalate due to conflicts, climate change and health crises. Humanitarian logistics involves coordinating relief operations throughout all stages of a disaster, as follows: mitigation, preparedness, response and recovery. These tasks typically occur under significant pressure, constrained resources, degraded infrastructure and insufficient expertise. Several studies confirm that even sophisticated digital or analytical tools deliver limited value unless stakeholders collectively understand and trust the underlying system structure [3]. Effective coordination and decision making are essential elements in such environments to mitigate human suffering and optimize the utilization of limited resources [1,4].

However, collaboration among disparate participants continues to pose persistent challenges. In particular, the field requires cooperation among diverse stakeholders like governmental entities, non-governmental organizations, international organizations and the private sector, each with its distinct requirements and particularities [5]. Fragmentation can lead to unmet demands, redundant efforts and resource inefficiencies. Organizations like the World Economic Forum assert that insufficient planning and coordination mechanisms result in more than 80% of humanitarian donations being squandered or rendered unnecessary [6] (as reported in 2024). This case underscores the pressing necessity for improved tools and methods to ensure that assistance efficiently reaches the intended beneficiaries and streamlines humanitarian response operations.

Given these operational challenges, humanitarian organizations have begun exploring advanced technological solutions, particularly artificial intelligence (AI) applications, to facilitate more agile, data-driven approaches. AI is being examined for its potential to enhance decision making, improve situational awareness and improve collaboration within complex supply chains like the ones pertaining to the humanitarian sector. AI enhances the efficiency and precision of humanitarian interventions, ranging from drone deployment for medical aid delivery in remote areas to route optimization through real-time data analysis [7]. Survey data from 171 international NGOs show that AI-BDAC strongly enhances both the agility (speed and flexibility) and resilience (robustness and adaptiveness) of humanitarian supply chains. Importantly, the authors argue that traditional theoretical lenses such as the resource-based view fall short because humanitarian supply chains operate under fundamentally different logics than commercial systems. By advancing the practice-based view, they demonstrate that routinized analytics practices—not rare resources—drive performance in volatile disaster contexts [8]. Nevertheless, the adoption of AI raises concerns regarding infrastructural readiness, algorithmic bias and data governance [9], thus necessitating a thorough evaluation of its ethical and practical implications.

The existing literature recognizes the increasing significance of humanitarian logistics as an essential element of effective disaster response, particularly in the context of escalating crises, constrained resources and the pressing demand for swift relief delivery [1]. Humanitarian logistics differs from commercial logistics because its primary goals are speed, coordination and reducing human suffering in extreme and unpredictable circumstances [2]. AI has emerged as a promising solution in this domain, offering predictive analytics, optimization algorithms and real-time situational awareness that can substantially enhance rapid, evidence-based decision making and considerably improve logistics performance and support [3,10,11]. AI solutions are particularly promising for bridging communication barriers, facilitating inter-organizational collaboration and enhancing operational efficiency across fragmented humanitarian networks [12,13].

Despite these advancements, several significant gaps remain. The literature offers limited empirical evidence regarding the specific impact of AI on coordination and decision making in real-world humanitarian contexts [14]. While the technological benefits of AI are extensively established, there is less understanding of how AI may facilitate the establishment of cooperative networks and eliminate institutional barriers. Furthermore, operational studies are inadequate in addressing ethical concerns, such as algorithmic bias, data privacy and excessive dependence on automated systems [15–17]. Finally, there are no theoretical models designed to address the specific ethical and logistical needs of the humanitarian sector. These limitations necessitate grounded, practice-oriented research that captures the complex dynamics of AI integration in humanitarian efforts.

The present study addresses these concerns by relying upon original empirical data derived from in-depth interviews with domain experts actively engaged in humanitarian logistics. Following a GT methodology, these interviews served not only as a primary data source but also as the analytical backbone through which thematic categories and conceptual linkages were inductively developed. While the study does not incorporate experimental trials or performance metrics, this design choice reflects the exploratory nature of our research aim to formulate a theoretical understanding of how AI is currently being perceived and applied in preparedness and mitigation phases of humanitarian logistics. This qualitative approach is particularly suited for contexts like ours, where the diffusion of AI remains emergent and heterogeneous and theoretical constructs must first be inductively generated before being subjected to future empirical testing. By explicitly positioning the interview corpus as empirical evidence, we respond directly to the need for data-grounded insight while remaining methodologically aligned with the objectives of early-stage theory building.

This study is structured into five sections. Section 2 provides a review of the literature, examining the role of humanitarian logistics and the growing impact of AI in this field. It outlines key benefits such as improved coordination and efficiency while addressing ongoing challenges like limited data access and ethical concerns. Section 3 explains the research methodology, detailing the use of Grounded Theory (GT) and the data collection process, which included interviews with logistics professionals and document analysis. Section 4 presents the main findings, highlighting the themes that emerged from the data and illustrating how AI influences decision making and coordination in humanitarian operations. Section 5 discusses these findings in relation to the existing literature, offers practical strategies for organizations to adopt AI effectively, addresses the study's limitations and proposes directions for future research.

2. Literature Review

AI plays a crucial role in humanitarian logistics, especially by helping relief operations become faster, more coordinated and more efficient. Among others, AI can deliver real-time updates, predict sudden spikes in demand, help reroute deliveries and allow instant team communication in various humanitarian emergency settings. Arguably, the integration of AI in the humanitarian sector has gained significant academic traction over the last years and is driven by the need for more agile, responsive and ethical interventions in crisis settings. The following three major thematic areas emerge from a closer analysis of the relevant literature: (1) operational efficiency and decision making, (2) supply-chain management and (3) ethical, legal and other challenges.

2.1. AI-Enhanced Decision Making in Humanitarian Response

Effective decision making is fundamental to humanitarian operations, particularly in disaster-response settings in which timely action and well-organized efforts can directly influence the survival and well-being of affected populations. The growing scale and severity of natural disasters, armed conflicts and public health emergencies have underscored the urgent need for resilient logistics systems capable of operating under pressure and in constantly shifting conditions [18]. To this end, AI has demonstrated significant potential in transforming humanitarian decision making from reactive to anticipatory models. For example, David et al. [19] underscore how AI and simulation technologies support anticipatory action, thus allowing for pre-positioning of resources and effective crisis-scenario planning. This attribute is also evident in other studies [15], which emphasize AI's potential in linking early warnings to action. In particular, Beduschi [15] frames AI as a catalyst for shifting humanitarian action away from ex post response to ex ante anticipation. Drawing on examples such as predictive displacement modeling, the author argues that AI can help agencies forecast needs and pre-position resources more efficiently. Several studies illustrate how AI enables improved situational awareness and faster crisis response. Other studies focus on AI's role in complex emergency decision making, especially in data-scarce environments [20].

In the context of humanitarian logistics operations, making sound decisions often involves navigating highly uncertain environments where time is limited and resources are, most of the time, scarce. Decision makers must quickly assess needs, determine which actions to prioritize while ensuring that limited resources are used in ways that create the most value for the affected populations [21]. Traditional methods tend to rely heavily on past experiences and expert judgment. However, these approaches may fall short in providing timely and accurate guidance during rapidly unfolding emergencies. AI offers a new layer of support by handling vast amounts of complex data quickly and precisely. Advanced machine learning makes it possible to draw insights from diverse and real-time information streams, either ranging from satellite imagery and social media content or from data from connected devices on the ground [22]. Several synergies exist between AI and other technologies like big data, especially highlighting their complementary role in aiding decisions under insurgency and disaster conditions [7]. These insights can play a critical role in forecasting potential disasters, such as tracking weather anomalies or identifying high-risk geographic areas. Predictive models can anticipate what supplies will be needed and where, allowing teams to strategically position relief goods in advance and significantly reducing delays in response efforts [8].

AI has the potential to transform how humanitarian logistics operate, especially by helping to fill some of the most significant gaps in traditional disaster-response systems. For instance, using AI organizations can analyze past and real-time data to predict the impact of a disaster and estimate where resources will be needed. This helps decision makers act faster, prioritize better and, eventually, get aid to the people who need it most without unnecessary delays [3]. In addition, AI systems with smart cameras and facial recognition can also help detect unrest early and support timely interventions to prevent violence from escalating [7]. Finally, AI systems like "cogSolv" and "cogResolv" offer a deeper understanding of conflict situations. These tools factor in cultural, psychological and practical aspects, helping to simulate the human dynamics behind conflicts. This makes it easier to design peacekeeping missions that are culturally respectful and less likely to provoke tension. By reducing bias in negotiations and increasing local engagement, AI can lead to more effective and fair solutions in some of the world's most challenging crises [23].

2.2. AI in Humanitarian Supply Chains

Arguably, the most prominent applications of AI revolve around supply-chain agility and logistics optimization. Pereira and Shafique [24] and Dubey et al. [8] conclude that AI-driven big data analytics enhance agility and resilience in humanitarian supply chains, especially by improving information alignment and reducing complexity. Shrivastav and

Sareen [25] use social media data to identify user perceptions and confirm that AI can address coordination, logistical and environmental challenges in humanitarian supply chains. AI also strengthens logistics planning by enhancing routing decisions. Intelligent algorithms can account for a range of disruptive factors, including damaged infrastructure, safety concerns and changing environmental conditions. This becomes especially important during the final delivery stages, where reaching isolated or heavily impacted areas is often the most significant challenge [26]. AI helps streamline decisions in these critical moments, making them faster and more accurate, ultimately contributing to a more effective and timely humanitarian response.

AI's convergence with other technologies, such as blockchain and 3D printing, is also pivotal. Rodríguez-Espíndola et al. [27] propose a framework integrating AI with disruptive technologies to improve transparency, traceability and collaboration in humanitarian logistics. Similarly, Ahatsi et al. [28] emphasize the combined role of AI and big data in enhancing supply-chain resilience. Operational-level improvements are detailed in studies such as by Rajalakshmi et al. [29], where machine learning is used for real-time logistics and resource allocation. Karuppiah et al. [30] provide an evaluative framework identifying drivers of AI adoption in humanitarian supply chains, including organizational preparedness, job security and policy support through to advanced multi-criteria decision-making methods.

Coordination among key participants and stakeholders within the humanitarian ecosystem is also crucial. Swift and well-coordinated action across all levels, like government bodies, non-governmental organizations, international agencies and local communities, is often essential in humanitarian logistics. AI offers promising solutions to these challenges by enabling seamless information sharing and improving the compatibility of systems that were not originally designed to work together. AI-powered platforms can bring together a wide range of actors—from international humanitarian agencies to grassroots organizations—by providing a shared, real-time overview of the situation. This joint perspective supports both strategic planning and day-to-day operations [31].

In addition, tools based on natural language processing can ease communication across diverse teams by bridging language barriers, thereby improving mutual understanding among international partners. AI also supports continuous monitoring through real-time data analysis and feedback mechanisms, allowing for plans to be updated dynamically as conditions change. This adaptability is vital in disaster response, where the environment can shift rapidly and in a timely manner, and flexible decision making is often the key to saving lives [32]. Another significant advantage of AI is its ability to improve coordination among different humanitarian groups. By combining information from many sources, AI helps create a shared view of the situation. This allows organizations to focus on the most vulnerable groups during the planning stage and on the hardest-hit communities when responding. It helps reduce overlap, avoids wasting resources and ensures that help goes where it is needed most [12]. AI can also smooth out collaboration even when organizations have different goals or ways of working [13]. Tools like face-tracking software—such as Trace the Face—and chatbots provide a way for loved ones to find each other and for affected communities to receive critical updates [33].

AI also brings a new efficiency level to logistics through powerful optimization tools. These algorithms can determine the quickest and most cost-effective routes in the middle of chaos—where every second counts. AI-powered decision-support systems gather information from many different sources to give responders a clear picture of what is happening on the ground, helping them make faster, smarter decisions [11]. In addition, AI can simulate various disaster scenarios to improve how to choose suppliers and manage resources, aiming to reduce unmet needs and cut costs while keeping suppliers viable. This strengthens disaster preparedness and helps organizations respond more effectively when a real crisis hits [34]. AI can even forecast potential risks and trends, giving teams a head start in preparing for future emergencies [10].

2.3. Ethical, Legal and Other Considerations of AI in Humanitarian Settings

Despite its operational advantages, the deployment of AI in humanitarian contexts raises ethical and legal concerns. Ashrafian [35] introduces the concept of AI-on-AI ethics, calling for universal robotic laws that acknowledge the dignity of intelligent systems and prevent intra-AI exploitation. Kreutzer et al. [36], in a comprehensive scoping review, categorize ethical issues related to AI into autonomy, beneficence, non-maleficence and justice, highlighting privacy breaches and the disproportionate impact on vulnerable populations.

Legal implications are also evident in military and humanitarian intersections. Trusilo and Danks [37] suggest that integrating humanitarian notification systems into military AI surveillance can enhance protection for relief operations. Putro et al. [38] explore the risk of AI deployment in military applications violating humanitarian law principles, especially in regions like Southeast Asia, and call for ASEAN-led regulatory safeguards. Shrivastav and Sareen [25] similarly highlight the gap between AI applications in high- and low-resource settings.

One of the most pressing issues is the scarcity of high-quality, reliable data. In many crisis settings, real-time and dependable data are difficult to obtain, significantly hindering the performance of AI systems that rely on extensive and well-structured datasets. According to Schiffling et al. [2], damaged infrastructure, ongoing security threats and limited technological capacity are frequent barriers that compromise data collection and accuracy during emergencies. Another critical challenge involves technical incompatibility. For instance, many humanitarian organizations still operate using legacy systems that are often incompatible with modern AI platforms. This technical incompatibility presents several limitations and requires substantial investment in infrastructure and staff training, which can be prohibitively expensive [39]. In addition, ethical considerations also present major concerns. Questions surrounding data privacy, accountability and the appropriateness of allowing AI to make high-stakes decisions continue to emerge [15]. Addressing these ethical and legal concerns is essential for responsible AI implementation [17]. Furthermore, there are growing concerns about the impartiality of AI systems and the risk of reinforcing biases, which may compromise the independence of humanitarian actions [40]. An over-reliance on machine-generated outputs can also lead to flawed judgments or decision-making errors [41]. Additional concerns may relate to the broader societal implications of AI, including the potential to increase social inequalities, enable invasive surveillance, foster authoritarian practices and influence human behavior and autonomy [8,16].

Financial limitations add yet another layer of complexity. For example, many humanitarian agencies operate within strict budget constraints, making investing in costly AI solutions difficult [36,40]. In addition, funding often depends on external sources, and, even when resources are available, limited technical expertise can hinder effective implementation of AI applications. Most organizations lack the specialized personnel or training to efficiently operate AI technologies [8,30]. Strategic partnerships with technology firms, academic institutions and other entities could offer practical solutions by providing access to tools, training and ongoing technical support.

3. Methodology

3.1. Grounded Theory

This study investigates how AI is used to support decision making and coordination in humanitarian logistics by applying a GT approach. The overall methodology relies upon structured, in-depth interviews from experts working in the humanitarian sector. In particular, the research engages professionals actively involved in logistics and humanitarian operations, drawing on their practical knowledge and experience. These interviews aim to uncover current practices related to AI adoption, identify anticipated benefits and explore the obstacles that may hinder integration within the humanitarian logistics operations.

It is worth mentioning that the study is grounded in empirical data collected through in-depth interviews with experts in humanitarian logistics. Using a GT approach, these interviews served as the primary source for inductively developing thematic categories that reflect how AI is perceived and applied in preparedness and mitigation processes. While not experimental in nature, this qualitative design is methodologically appropriate for early-stage theory building in an emergent field like AI in humanitarian logistics.

The interview protocol was designed to align with the study's three core research questions (RQ) while still allowing respondents the flexibility to share individual insights and lived experiences, as seen in Table 1. In particular, the discussions with the experts explored how decision making and coordination are currently practiced in humanitarian logistics (RQ1), the potential applications and benefits of AI in improving planning and coordination (RQ2) and the practical, ethical and organizational challenges involved in AI integration (RQ3). Each area was further examined through targeted sub-questions addressing operational dynamics, technological capabilities and the contextual limitations across humanitarian settings.

Table 1. Research questions and objectives.

No.	Question	Objective
RQ1	How are decision making and coordination currently practiced in humanitarian logistics operations?	To understand existing decision-making and coordination methods.
RQ2	In what ways can AI enhance planning and coordination in humanitarian logistics networks?	To explore how AI might enhance supply-chain planning and coordination.
RQ3	What are the main challenges to integrating AI in humanitarian logistics operations?	To identify barriers to AI integration in humanitarian logistics.

We used a semi-structured interview guide comprising three primary open-ended questions and six optional probes; no closed-ended items were used. The questions covered included the following: (i) current decision-making and coordination practices in humanitarian logistics; (ii) how AI could optimize networks, planning and inter-organizational coordination across phases (mitigation, preparedness, response, recovery); and (iii) anticipated implementation challenges (technology adoption, staff training, real-time decision making and alignment with human judgment and cultural nuance). Probes were employed selectively to elicit clarification or elaboration. The complete guide, exactly as administered, appears in Appendix A (Table A1).

Interview transcripts were analyzed using GT methods, supported by MAXQDA 2022. This approach enabled the identification of recurring themes and patterns related to AI's role in decision making and coordination within humanitarian logistics. GT is well suited to building theory directly from empirical data rather than testing predetermined hypotheses [42,43]. From a methodological point of view, its coding process helps distill large volumes of qualitative information into structured insights through constant comparison, theoretical sampling and saturation. These principles make it especially effective for uncovering complex topics such as logistical decision making [44–46]. Combining GT with structured interviews allows for a grounded interpretation of AI's influence based on the lived experiences of humanitarian professionals. Insights from a focused sample contribute depth rather than breadth, aligning with qualitative research goals and prioritizing meaning over representativeness [47].

This study employed a purposive sample of five elite experts whose roles span both humanitarian logistics coordination and AI implementation. While small in number, the participants offered high information richness and thematic diversity within a narrowly defined expert domain. Consistent with GT principles, sampling continued until theoretical saturation was reached. For example, no new categories or properties emerged and existing themes were densely developed. As GT rigor depends on conceptual saturation rather than a fixed sample size, this expert-informed, theory-generative sample was deemed methodologically sufficient. The rationale for this sampling strategy and the saturation point are detailed also in the literature [48].

Figure 1 presents the overall methodology adopted. The flow chart outlines the study's grounded-theory method in nine linked stages. As seen in Figure 1, it begins with ethical approval, purposive expert sampling and interview design. It then moves through data collection, preparation and an open-to-selective GT coding cycle. It ends with saturation checks, theory construction and final reporting.

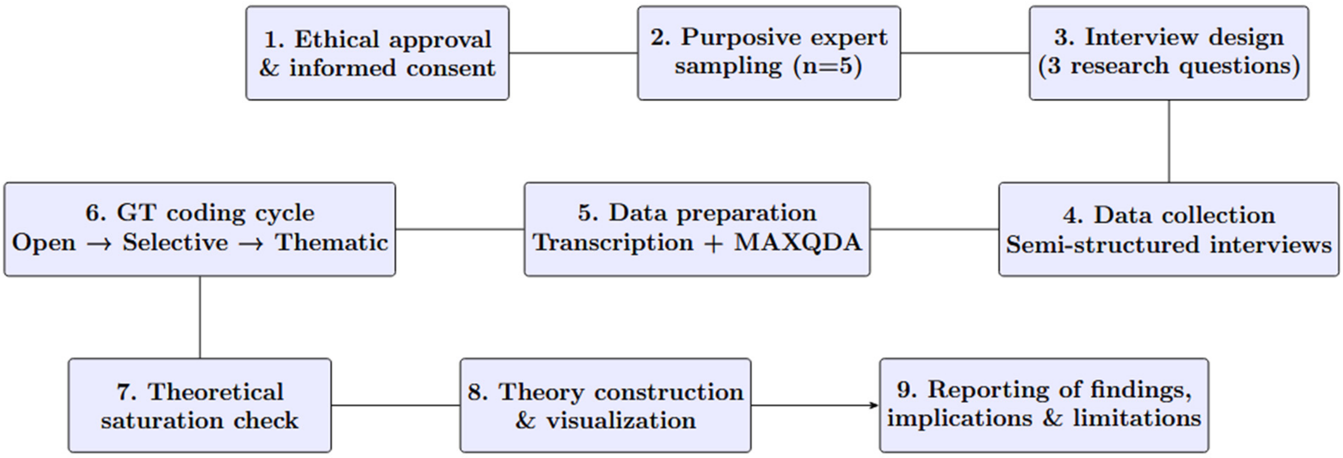

Figure 1. Flow chart of the overall methodology adopted.

3.2. Expert Selection

This study used purposive sampling to explore how AI supports decision making and coordination in humanitarian logistics. Given the specialized nature of the topic, participants were selected based on their practical involvement and professional expertise in logistics operations and their familiarity with AI applications in the humanitarian sector. This approach prioritizes in-depth insight over statistical generalization, aligning with the qualitative design of the research [31].

Five professionals were interviewed. They represent a mix of operational, technical and academic perspectives and hold leadership and hands-on roles in logistics coordination, innovation, emergency response and research in humanitarian organizations. Their collective experience provided a well-rounded foundation for investigating the integration of AI into humanitarian logistics. The overall experts' backgrounds and areas of expertise are summarized in Table 2.

Table 2. Professional background and expertise of selected experts.

Expert	Professional Expertise
A	Senior regional logistics coordinator with an international humanitarian organization. Experienced in supply-chain management, procurement, and emergency-response operations.
B	Senior manager leading a technology team that delivers solutions for the humanitarian sector, managing international projects in areas such as AI-driven preparedness, logistics, and information management.
C	Experienced humanitarian logistics volunteer deployed on multiple missions internationally. Also trained logisticians in various regions.
D	Academic expert in humanitarian logistics and director at a university research centre, focusing on the intersection of logistics and technology integration.
E	Senior manager in a humanitarian technology company, with prior field experience in emergency operations.

Ethical approval was obtained in accordance with institutional guidelines, with all participants providing informed consent and assured anonymity. Each expert was interviewed once using a semi-structured interview guide. Interviews lasted approximately 30–40 min, were audio-recorded with permission, professionally transcribed verbatim and cross-checked against the recordings for accuracy. These procedures ensured ethical compliance and data integrity while supporting consistent thematic analysis. We conducted the semi-structured interviews with participants during the period from 24 October to 13 November 2024. The dates of the interviews were the following:

- Expert A—24 October 2024;
- Expert B—24 October 2024;
- Expert C—1 November 2024;
- Expert D—6 November 2024;
- Expert E—13 November 2024.

3.3. Content Analysis

The analysis of the interview data was conducted using MAXQDA 2022, a specialized software for qualitative research. This tool provided structured support throughout each stage of the GT, ensuring that the process remained rigorous and transparent. The analysis was carried out in the following four phases:

1. Initial coding of transcripts: The interview transcripts, prepared from conversations with logistics professionals and humanitarian practitioners, served as the foundation for analysis. In accordance with GT principles, coding began with an open, exploratory phase. Open coding involved closely examining the text without any predefined framework. Codes were created freely to reflect distinct concepts emerging from the data. This phase allowed for a wide variety of ideas to be identified and documented. Selective coding followed, where attention shifted toward identifying broader, more meaningful patterns. Related codes were grouped, refined and organized at this stage to reveal recurring themes and deeper insights.
2. Structuring the coding framework: As the analysis progressed, the coding system was refined through multiple rounds of selective coding. Concepts were organized in a hierarchical format using parent and sub-codes, which helped clarify relationships

among emerging ideas. This structure made it easier to navigate the complexity of the data and ensured consistency in interpretation.

3. Thematic grouping and categorization: Similar concepts were brought together under broader thematic categories. These categories served as the building blocks of the developing theory. They offered a way to organize abstract ideas into a more structured format, highlighting the underlying connections and relationships reflected across the interviews.
4. Developing the theory: With the categories in place, the next step was to explore how they related to each other. Theoretical sampling helped refine and extend the developing framework. By focusing on the most significant connections among categories, the study moved toward forming a cohesive and grounded understanding of the phenomenon under investigation.

4. Data Analysis and Findings

4.1. Overview of Data Collected

This section presents the main insights drawn from structured interviews with five professionals actively engaged in various roles within humanitarian logistics. Their expertise spans logistics coordination, supply-chain management, field operations and strategic planning. Their contributions shed light on how AI is currently perceived and potentially applied in humanitarian logistics, particularly in relation to decision making and coordination. The interviews were guided by the following three core sets of questions (and relevant sub-questions): (a) the participants' current approaches to logistics operations, (b) how AI might optimize supply-chain coordination and (c) the challenges they foresee in adopting AI within humanitarian contexts. Using the principles of GT, the analysis followed a structured process comprising the four key phases described earlier.

4.2. Thematic Key Areas

4.2.1. Balance Between Experience and Data Constraints in Humanitarian Coordination and Decision Making

The discussion with the interviewees revealed how humanitarian logisticians constantly try to strike a balance between drawing on their own experience and dealing with the limitations of data availability and technological resources. In particular, their reflections underscored that decision making and coordination in humanitarian logistics are complex processes. All decisions and subsequent actions are influenced by a complex and often demanding interaction between human judgment and digital information. The following three interrelated topics emerged from their insights: (a) decision-making processes and information management, (b) technological utilization and (c) the crucial role of human engagement.

Interviewees expressed a persistent dependence on experience, particularly when timely and reliable information are difficult or impossible to obtain. For example, Expert B mentioned that "*You have access to 10% of the information… and you have to fill the 90% with assumptions, simplifications, whatever, experience from other missions*". In humanitarian conditions, decisions are frequently influenced by field experience, personal networks and an understanding of local dynamics. While there is a strong preference for data-driven decisions, technological limits, variations in data standards and siloed information systems make this difficult to achieve. Accurate real-time gathering of information remains a considerable challenge, exacerbated by language difficulties and cultural variations. All these particularities can prevent effective communication and undermine decision-making processes. Arguably, in such situations, logisticians often return on their experience to fill the gaps.

In terms of technology, the interviews revealed that although a range of digital tools are available, these are not always used to their full potential. For example, Expert D mentioned that "*They do collect a lot of data... but they don't necessarily have the time, resources or the skills... so they still use a lot of pen and paper*". Advanced warehouse management software and RFID tracking are two examples of technological solutions that are still mostly ignored despite being developed to automate logistical procedures. The main causes of this underutilization include lack of skilled personnel, limited resources and reluctance to implement new systems. Numerous organizations still rely on manual processes, which can hinder humanitarian operations and lower the accuracy of field-based data transfer. As a result, efforts to move from experience-based approaches to data-driven strategies are often stalled. More significant investment in training and support systems was seen as essential for closing this gap and unlocking the benefits of technological integration.

People play an underlying and crucial role in all these challenges. Arguably, the human factor is essential to logistics operations, particularly in emergencies. Experience frequently serves as an alternative when data systems collapse or when real-time information is inaccessible. Nonetheless, technology's role is significantly dependent upon individuals, particularly those who are eager to learn, adapt and embrace innovative approaches. Training emphasizes technical competencies, enhancing confidence and mitigating resistance, especially among experienced workers who may prefer traditional approaches. In the absence of human preparedness, even the most sophisticated technological tools are unlikely to achieve substantial change in humanitarian emergencies.

4.2.2. Barriers to Accessing Reliable Data in Time-Sensitive Humanitarian Decisions

The interviewees highlighted the difficulties in accessing reliable, real-time data as a significant barrier to effective decision making in humanitarian logistics. Expert B mentioned that "*We have chronically two main issues... data translation and data access... language barriers... information A and B from two sources that just don't match*". Their insights have demonstrated how deeply these data-related challenges affect the ability to act quickly and accurately in emergency settings. The discussions suggest that addressing this issue requires not only technological upgrades but also broader efforts, including improvements in data collection and sharing, training staff to manage it efficiently and promoting easy-to-use and adaptable systems across organizations. A coordinated approach that connects technology, personnel skills and a culture of collaboration would help build a stronger foundation for timely and informed decisions in humanitarian operations. Two important dimensions emerged from the empirical data, as follows: (a) the pressure of acting under extreme time constraints and (b) the ongoing difficulties relevant to data collection and processing.

Respondents emphasized how the urgent nature of disaster response often leaves little room for analysis. Expert C mentioned that "*Some people... do it on the papers and then... Excel sheet... it might be wrong or not efficient... you have to do it all in a rush time*". In fast-moving situations, humanitarian professionals lean heavily on their own experience when decisions must be made within minutes. It is almost impossible to stop and verify every piece of information due to the pace of operations and the overwhelming amount of raw data. Therefore, operational judgment, which has been developed over the course of years in the field, becomes essential. When accurate information is inaccessible or delayed, actions are frequently dictated by experience with local conditions, trusted networks and on-the-spot evaluations. In these circumstances, decisions are made more on the basis of instinct and previous experience than on a comprehensive, data-driven analysis.

Equally pressing are the challenges relevant to data gathering and processing. For example, information, when available, is often incomplete or inaccurate, particularly in conflict zones or areas with limited infrastructure. Security concerns and political instability may obstruct access to critical data. Even when data can be collected, organizations face shortages of trained personnel who can handle it in an efficient manner. Also, the heavy reliance on volunteers in field assessments presents another complication. In particular, volunteers are often overwhelmed in disaster scenarios, making it difficult to allocate time for data entry and validation. This leads to errors, inconsistencies and, unfortunately, missed details. As a result, decision makers are frequently caught in a difficult situation—faced with too much raw, unrefined data but very few actionable insights.

4.2.3. The Essential Role of Coordination and Relationships in Logistics Management Across Humanitarian Stakeholders

The interview insights underscored the critical importance of coordination and relationship-building in the process of navigating the intricate logistics networks that involve multiple humanitarian actors. No matter if it is the management of emergency supply chains or the response to sudden-onset crises, successful operations are dependent on effective collaboration among diverse stakeholders. In the absence of that, the probability of misaligned priorities, misused resources and duplicated efforts increases significantly. There are more than just logistical barriers for coordination. At times, they are intertwined alongside greater concerns, including political influence, fragmented systems, different organizational mandates and significant disparities in authority and capacity. In such a setting, coordination requires more than tools and structures—it demands trust, transparency and consistent dialogue.

Interviewees spoke about the value of direct engagement among key players, including local governments, international partners and non-governmental organizations. Expert D mentioned that "*Coordination is very, very challenging... because of the different incentives that all the different players have*". Regular interaction, mainly through structured meetings such as inter-agency clusters, was seen as a practical way to align efforts and share updates. However, coordination is only as effective as the relationships it is built upon. Trust and openness are critical, especially when political tensions or cultural sensitivities complicate operations. The exchange of information—vital to good coordination—is often hindered by concerns over data protection and the reluctance of organizations to share internal systems, further limiting collaborative potential.

Managing resources in this environment is also shaped by uncertainty. When accurate inventory data are lacking, logisticians rely on historical stock levels, contingency reserves and personal judgment. Financial limitations often force difficult decisions about how to allocate resources, especially when information is incomplete. Shared assets such as transport or warehousing can improve efficiency, but these arrangements demand clarity on liability, roles and data standards—something not easily achieved in multi-stakeholder settings.

Beyond technological limits, political and cultural considerations emerged as key influences on coordination. Coordination is frequently more cohesive in areas where government institutions are stable and active. Where governance is lacking, efforts tend to divide, with rival systems developing and communication connections failing. Political objectives can impact assistance distribution and neutrality. Political interests may shape everything in such contexts, from recipient validation to the establishment of agreed objectives. Cultural variations make situations more complicated. Misunderstandings can occur when local customs, traditions and languages are not fully respected. Without cultural awareness, well-intentioned cooperation can cause confusion or even offense, weakening community trust. As a result, effective coordination depends on actors' ability to adjust to these cultural dynamics while retaining common goals and operational efficiency.

4.2.4. Using AI to Improve Planning and Efficiency in Humanitarian Logistics

Expert interviews disclosed that AI has the potential to significantly enhance the performance of humanitarian logistics. AI provides practical tools to enhance the speed, precision and flexibility of operations in crises, from refining supply chains to supporting complex decision making. AI facilitates improved planning, more precise resource allocation and more effective stakeholder coordination when implemented effectively. Nevertheless, it is imperative to ensure that technological capabilities are in accordance with the distinctive obstacles of humanitarian contexts in order to completely capitalize on these advantages. In order to guarantee ethical and effective implementation, this necessitates targeted investment, enhanced data practices, staff training and ongoing human oversight. The following three primary themes were identified during the analysis, which underscore the transformative potential of AI in this field: the significance of customizing AI models to the unique realities of humanitarian response, its capacity to conduct predictive simulations in real time and the operational enhancements it can provide.

Interviewees underscored that AI has the potential to significantly improve logistical operations by optimizing data management and information processing speed. This facilitates more precise forecasting, more responsive distribution networks and improved supply-chain management. Expert B mentioned that "*So we are, for example, also experimenting with language models that read through narrative data and try to build a structure data points out if it works like a charm, but of course has all the shortcomings that you can probably see*". Automated updates on inventory levels, demand and shipping routes can mitigate delays and enhance preparedness prior to the onset of a crisis. Additionally, AI provides substantial assistance in the management of intricate coordination initiatives, particularly when multiple stakeholders are involved. Collaboration is expedited and more precise with the assistance of tools like real-time data analysis, pattern recognition and instant translation. These capabilities enable humanitarian actors to anticipate requirements and respond promptly to emerging threats, thereby supporting proactive decision making.

AI's capacity to simulate real-time "what-if" scenarios is another area of significant impact. The optimal delivery routes and operational plans are suggested by these simulations, which refer to current data, including traffic, weather and infrastructure conditions. Expert C mentioned that "*And then this is where simulating a real time scenario would be, yes. Dynamic route planning, yes, sure. Because you start with information, data collection, and then planning, and then executing*". Organizations can mitigate risks and prevent delays by conducting scenarios testing prior to taking action. Enabling faster and more confident judgments during high-pressure situations, this ability to visualize outcomes in advance is significant. Predictive analytics also facilitate the more precise estimation of resource requirements, thereby enabling more effective planning and efficient utilization of limited supplies. As a result, AI promotes a more adaptable and agile humanitarian logistics approach that can rapidly adjust to changing conditions on the ground.

Notwithstanding its potential, AI cannot be utilized in humanitarian operations as it is in commercial logistics. The environments are inherently distinct. Humanitarian contexts can entail swiftly evolving circumstances, restricted data accessibility and operational unpredictability. AI models designed for steady, data-abundant commercial settings must be modified to fulfill the requirements of humanitarian efforts. These adaptations are crucial to guarantee that the models generate pertinent, realistic outputs that facilitate informed decision making in crisis situations. Understanding the differences in scale, data and complexity between the two domains is essential for creating AI tools that are both technically sound and practically applicable.

4.2.5. Strengthening Humanitarian Preparedness and Mitigation Through Responsible Use of AI

Discussions with the interviewees highlighted AI's important role in improving decision making and coordination in humanitarian logistics, particularly during the early phases of preparedness and mitigation. Expert A mentioned that "*It's perhaps better to start with the less exposed one, like mitigation and preparedness. That will be the most high valuable phases*". While the response phase continues to rely heavily on human judgment due to its urgency and unpredictability, earlier phases provide a more stable environment where AI can deliver significant benefits. However, realizing this potential also requires confronting challenges such as the need for ongoing training, building trust in AI systems and ensuring human oversight remains at the core of operations.

The preparedness and mitigation stages were the most appropriate entry sites for AI in humanitarian logistics, as agreed by experts. Contextual clarity, more stable conditions and increased access to structured data are all provided by these periods. Organizations can pre-position supplies in high-risk areas, model disaster scenarios and conduct a thorough analysis of risks with fewer time constraints. AI assists in the formulation of decisions prior to the onset of a crisis by simulating potential events and evaluating probable outcomes. A more intricate environment for AI applications is presented by the response and recuperation phases, in contrast. The efficacy of even the most advanced systems is often restricted by the necessity of making real-time decisions in chaotic conditions with limited or unreliable data. In order to overcome this obstacle, the consistent integration of AI into all aspects can facilitate a more seamless exchange of information and enhance the continuity of decision making. This integration establishes a connection between planning and action, while also guaranteeing that the insights acquired prior to a crisis can inform the most critical responses.

Arguably, another recurring theme in the interviews was AI's capacity to enhance coordination and enhance decision making by providing quicker, more informed access to information. By providing real-time translation and enabling the seamless interchange of information among stakeholders, AI tools can assist in overcoming communication barriers, such as language differences. This is essential when multiple organizations collaborate, as it enhances the speed and clarity of communication. Additionally, AI facilitates the analysis of intricate datasets, which includes the identification of trends, the recognition of patterns and the generation of predictions that may have been disregarded in the absence of communication. For instance, AI has the capacity to analyze narrative reports that are unstructured and identify critical issues that facilitate planning decisions. AI alleviates the cognitive burden on employees and enables teams to concentrate on critical tasks by filtering vast quantities of information. This improves operational efficiency and facilitates a more cohesive response when prompt action is required.

Human involvement remains indispensable, regardless of these benefits. The value of experience, ethical reasoning and adaptability that practitioners contribute to the field cannot be replaced by AI. The nuanced comprehension that is necessary in unpredictable situations can be facilitated by technology, but it cannot be a substitute. The significance of training humanitarian workers to utilize AI tools, comprehend their functionality, interpret their outputs and acknowledge their constraints was underscored by experts. Additionally, human judgment is required to identify errors, rectify biases and guarantee that AI-generated insights are consistent with ethical standards. The capacities to improvise in real time and be flexible and creative are qualities that are distinctively human and essential to humanitarian work.

4.2.6. Confronting the Real-World Barriers to Using AI in Humanitarian Logistics

Expert perspectives revealed that while AI holds strong potential for improving humanitarian logistics, its integration into real-world operations remains far from straightforward. The path toward implementation is obstructed by various practical, ethical and technical challenges. These extend beyond the technology itself and touch upon trust, regulation, infrastructure and organizational-capacity issues. Expert A mentioned that "*Internet connection is really important... if you entirely rely on internet, it won't work... system can be used without internet*". For AI to become a meaningful part of humanitarian logistics, these concerns must be addressed through a well-rounded approach that includes thoughtful planning, sensitivity to context and a commitment to ethical standards.

Data security was the primary concern expressed by respondents. It is imperative to safeguard personal and organizational data in humanitarian operations, as work frequently takes place in politically sensitive or high-risk environments. It is imperative to protect confidential information in order to preserve the trust of donors, maintain legal and ethical standards and guarantee the safety of individuals, particularly those employed in conflict zones, such as those deployed by organizations like Médecins Sans Frontières. Sensitive logistical information that could be exploited if disclosed is also included in the scope of data protection. The integrity and credibility of humanitarian organizations could be compromised if this area is not addressed.

In addition to security concerns, ethical considerations are becoming more prominent in discussions regarding the use of AI. Respondents underscored the significance of complying with evolving legal frameworks, such as the European Union's AI Act, which aims to safeguard users' rights and promote transparency. Nevertheless, ethics extend beyond mere compliance. The environmental costs of AI, such as the high energy and water consumption associated with data centers and the cooling infrastructure that fuels them, were also a source of concern. Organizations are anticipated to exhibit a broader commitment to sustainability and responsible innovation, in addition to legal compliance. It is imperative to achieve a balance between accountability and progress in order to establish long-term viability and gain the trust of the public.

Despite noble intentions, many humanitarian groups encounter substantial obstacles in implementing AI. Financial limitations are a primary restraint, as budgets are frequently restricted and donor financing is often contingent upon conditions that may not support technological exploration. Deficiencies in infrastructure and a lack of qualified personnel also hinder the implementation and maintenance of AI systems. Moreover, certain donors exhibit reluctance due to their uncertainty over the utility or suitability of AI in humanitarian efforts. Beneficiaries may articulate apprehensions, favoring human interaction over automated technologies, particularly in situations where empathy and personal connection are essential. These uncertainties—stemming from financiers and communities—constitute significant impediments to advancement.

Another significant theme was the issue of applicability. Although larger organizations may be better equipped to experiment with AI, numerous small and mid-sized humanitarian actors operate with restricted data access, which is essential for training AI systems. Algorithms are less effective in the absence of large, high-quality datasets, which makes it challenging to justify the returns on investment. The scope of operations for these organizations may not be sufficient to support the infrastructure AI requires, and any benefits may be insufficient to compensate for the costs. In such cases, AI solutions must be designed with scalability and data limitations in mind. Tools that can function with smaller datasets, adapt to constrained environments and still deliver valuable insights are needed to make AI genuinely accessible in this field.

4.2.7. Bridging Human and Technological Gaps to Support Real-Time Use of AI in Humanitarian Logistics

Insights from the interviews underscored that the successful use of AI in real-time humanitarian logistics depends not only on the capabilities of the technology itself but also on addressing key human and operational challenges. Expert B mentioned that "*We have everything from language barriers, culture barriers, data standards, ways of engagements methods, procurement mechanisms and so on*". In particular, the respondents consistently pointed to the need for AI tools to be accessible, intuitive and capable of functioning within the relatively limited infrastructure found in crisis zones. Staff must be equipped with the skills and confidence to use these tools effectively without feeling that human knowledge and interaction are being replaced. A combined focus on infrastructure, training, system design and trust is essential to ensure that AI supports rather than disrupts humanitarian logistics.

A recurring concern expressed by the respondents was the current limitations of technology in the field. Many AI solutions are not yet designed with frontline humanitarian workers in mind. As a consequence, while advanced systems may work well in high-resource settings, they often struggle in environments where mobile devices are basic and technical literacy levels vary widely. Interviewees noted that for AI to be truly useful, it must be simplified and made compatible with commonly used devices. This would help bridge the gap between innovation and adoption, therefore ensuring that tools are practical for everyday use by teams with diverse skill sets.

Apart from these usability issues, infrastructure challenges remain a significant barrier. Poor road access, unreliable electricity and weak internet connectivity are common in disaster-prone or conflict-affected areas. Expert D mentioned that "…*there are also other challenges for example is they that are more basic is their electricity working in order to be able to do that is the internet or any kind of internet working right in order to be able to upload data into different kinds of tools*…". These limitations restrict the use of AI tools that depend on real-time data transfer, cloud processing or high bandwidth. Without a stable technological foundation, it becomes nearly impossible to maintain the accuracy and responsiveness that AI is meant to offer. The result is a fragmented system where not all stakeholders can benefit equally from AI-driven insights, limiting its collaborative potential during emergencies.

The role of human interaction emerged as a critical theme in shaping how AI is perceived and applied. Many seasoned staff members are deeply familiar with traditional systems and may resist the introduction of automated tools, particularly if they perceive AI as a threat to their role or as undermining the importance of human judgment. Others may be uncertain about how AI works or how to interpret its outputs. This highlights the importance of inclusive training that teaches technical skills and fosters a sense of participation and ownership among staff. Rather than positioning AI as a replacement, organizations should promote it as a support system that enhances, rather than diminishes, human expertise. Maintaining a balance between automated insight and emotional intelligence is key to preserving the values at the heart of humanitarian work.

Trust in AI was also identified as a major hurdle. Humanitarian operations involve high-stakes decisions that must be based on accurate and reliable information. Placing too much confidence in algorithm-generated outputs—especially when those outputs are shaped by incomplete or flawed data—can lead to serious missteps. Interviewees emphasized the need for human oversight to remain central in decision making, particularly in unpredictable or morally complex situations. AI systems should include built-in checks that encourage human verification, thereby increasing the accuracy of outcomes and users' confidence. Trust can only be built over time through consistent performance and transparency in decision making.

Finally, the pressure to make rapid decisions often leaves little time for AI tools to be fully utilized. In fast-moving emergencies, the instinct is to act immediately, based on experience and established practices. This reality can limit the usefulness of AI unless its outputs are instantly understandable and clearly actionable. A recommendation that requires significant interpretation or validation may be overlooked in favor of more familiar approaches. Again, this underscores the importance of designing AI systems that are technically advanced and responsive to the real-world conditions and time constraints of humanitarian operations.

4.2.8. Encouraging Inclusive AI Integration to Support Culturally Attuned and Coordinated Humanitarian Action

Insights gathered from the interviews revealed that while AI holds promise for strengthening coordination among humanitarian actors, its success will depend heavily on how well it respects cultural contexts, builds trust and supports collaboration across diverse organizational and regional landscapes. To truly exploit AI in a meaningful way, humanitarian organizations must address the tensions between data sharing, technological disparities and cultural sensitivities. Doing so requires a thoughtful approach that blends innovation with empathy and technical design with local understanding.

One of the recurring concerns raised by participants centered on the difficulty of achieving effective coordination in multi-actor humanitarian settings. Expert D mentioned that "*Coordination is very, very challenging… because of the different incentives that all the different players have*". Cooperation between governments, non-governmental organizations and private partners is essential but often difficult to sustain. Aligning objectives, securing access and mobilizing shared resources demand clear communication and mutual respect. These relationships are further complicated by differences in language and culture, which collectively can hinder understanding and delay decision making. Miscommunication may arise between institutions and in interactions with affected communities, particularly when cultural norms and values are not fully understood. Trust and inclusiveness become essential in such contexts and efforts to bridge these gaps must be intentional, either through multilingual strategies, cultural awareness training or the involvement of local voices in planning and implementation.

In addition to coordination challenges, participants noted that fragmented data systems and a lack of trust around information sharing frequently constrain collaboration. Expert C mentioned that "*If the source of information is wrong… all our analysis will go wrong…. The other challenge is the time itself within the real time disaster response*". Many organizations operate with their own platforms, using different formats, standards and security protocols. This lack of consistency creates obstacles to the seamless integration of AI tools, which often rely on large-scale, harmonized datasets to function effectively. Concerns around confidentiality further complicate the situation, as some actors may hesitate to share sensitive data due to fears of misuse or breaches. Addressing these concerns requires transparency, consistent communication and a demonstrated commitment to protecting stakeholder interests. AI must be positioned as a support mechanism, not a replacement for human roles. Showing how AI can enhance rather than disrupt current workflows is vital to earning trust among staff and partners.

Language and cultural context emerged as especially significant in AI-related applications. Translation is more than converting words—it requires understanding idioms, dialects and emotional understanding. Even advanced AI systems often struggle with these layers of complexity. The challenge is compounded when cultural misinterpretations risk alienating the communities' humanitarian organizations aim to help. Designing AI systems that interpret local norms, social behaviors and communication styles requires careful programming, continuous input from local actors and a deep appreciation for cultural variation. When AI tools are designed with this cultural intelligence in mind, they are far more likely to foster positive engagement and improve the quality of collaboration on the ground.

4.2.9. Addressing the Hidden Struggles of Data and Information Use in Humanitarian Decision Making

Insights from the interviews highlighted that the quality and management of data play a crucial role in supporting fast and accurate decision making in humanitarian logistics. When handled well, data can empower organizations to act swiftly and confidently. However, when flawed, incomplete, or mismanaged, it can quickly become a barrier rather than an asset. Expert E mentioned that "…and so I think for me, the problem is not so much with the collection, data collection is more with the data sharing, which I think when you look at your next point on the analysis, it's a limitation per se because it's difficult to analyze data you don't have, and still some humanitarian actors might be reluctant to share, you know, what is our logistic pipeline or what stuff do they have, and so I would say this is an issue".

One of the central concerns raised involved the quality of the data being used. Incomplete records, outdated information or biased inputs can undermine the reliability of AI systems, leading to poor decisions that may do more harm than good. Respondents emphasized that even the most advanced algorithms are only as effective as the data given. When those inputs are inaccurate or unbalanced, the results can reflect and even magnify existing weaknesses in the system. This makes data integrity a critical factor, not just for functionality but for the credibility of decisions made under pressure.

Beyond the issue of data quality lies the broader challenge of information management. AI systems, particularly in humanitarian settings, must process vast amounts of incoming data—often with limited resources and under time constraints. Expert D mentioned that "*They do collect a lot of data right but they don't necessarily have the time resources or the skills resources that's necessary at some point to use them in the decision making…*". Without precise mechanisms to filter and prioritize this information, these systems risk becoming overloaded, which can delay or distort decision making. Striking the right balance between what to include and what to leave out is no easy task. Excluding valuable information may compromise outcomes, while incorporating too much irrelevant data can lead to confusion or inefficiency.

In many disaster scenarios, the problem is compounded by data scarcity. The very nature of humanitarian crises often makes it difficult to collect comprehensive or reliable data in real time. In such conditions, AI systems are forced to operate with gaps in knowledge, making their support for decision making harder to rely on. Developing tools that work effectively despite these limitations is one of the field's most pressing challenges.

4.2.10. Thematic Synthesis of the Empirical Findings

To provide a visual synthesis of the empirical findings, Figure 2 presents a thematic map that organizes the core dimensions influencing AI integration in humanitarian logistics. Rooted in the interview analysis, the map groups the emergent themes into the following four overarching categories: Human Factors, Technological Constraints, Operational Realities and AI Opportunities. These categories reflect the central tensions articulated by practitioners—such as the reliance on personal experience amid data scarcity, resistance to system change and the infrastructural and organizational barriers to technology adoption. Simultaneously, the figure highlights AI's potential to enhance coordination, forecasting and decision making when adapted to the unpredictable and resource-constrained environments characteristic of humanitarian settings. This thematic representation captures not only the interconnectedness of challenges and enablers but also the evolving role of AI across various phases of humanitarian action—from preparedness to real-time response.

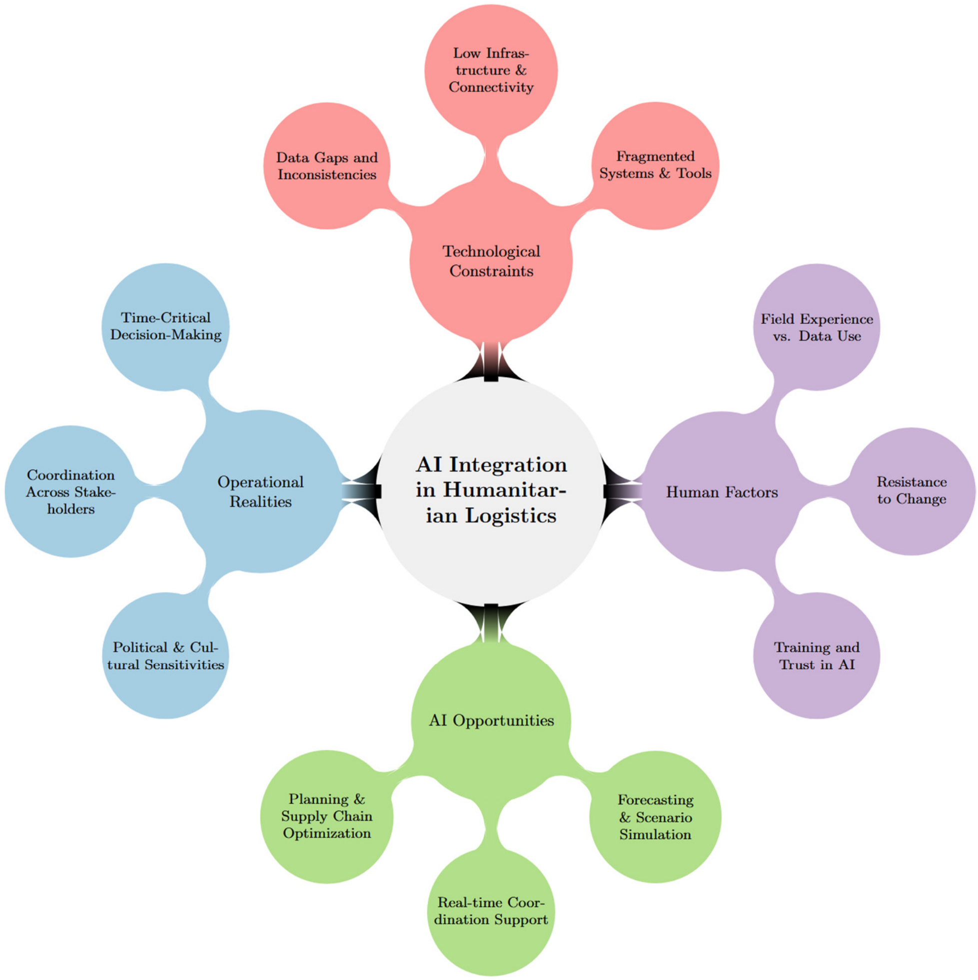

Figure 2. Thematic map of AI integration in humanitarian logistics.

4.3. Thematic Synthesis

The insights gathered across the preceding themes reveal a complex and evolving landscape for integrating AI in humanitarian logistics. Based on the analysis, although AI holds considerable promise for improving efficiency, enhancing coordination and accelerating decision making, this potential is deeply linked to a number of persistent challenges. These challenges stem from human and technological factors, ranging from skill gaps and organizational resistance to ethical concerns, infrastructure limitations and difficulties in managing and sharing data.

Arguably, one of the most consistent observations from the interviews was the continued reliance on personal experience and local networks in the absence of standardized, high-quality data. Despite the availability of advanced tools, the lack of adequate training, limited funding and a general hesitation to abandon traditional approaches have hindered full-scale adoption of AI in humanitarian logistics operations. This underscores the urgent need for targeted investment, not only in technology itself but also in developing the human capacity to use it in an effective way.

Effective coordination among diverse humanitarian actors remains central to operational success, yet political interference, language/cultural differences and incompatible systems make this a persistent struggle. In particular, AI can offer practical solutions by streamlining processes, improving communication and analyzing large data volumes to uncover insights supporting joint efforts. AI shows great strength in scenario planning, forecasting and real-time updates, particularly during the mitigation and preparedness phases. However, during the more chaotic response phase, its value is limited by the scarcity of usable data and the urgent need for rapid, experience-driven decisions. This contrast highlights the importance of balancing AI capabilities with human intuition and expertise.

Implementing AI in humanitarian logistics also raises serious questions about data security and ethics. For example, protecting sensitive information is a legal obligation and a foundational element in building trust with donors, partners and affected communities. Regulatory compliance, such as adherence to the EU's AI Act and growing environmental concerns, mainly related to energy and water consumption in AI infrastructure, add another layer of complexity. Small- and medium-sized organizations, in particular, struggle to justify the effort and cost of integrating AI, especially when data are limited and outcomes are uncertain.

A key point made by respondents was the need to keep people at the center of technological change. Resistance to AI often arises from fear of job loss, irrelevance or simply fear of the unfamiliar. To move forward, humanitarian organizations must offer inclusive training and create user-friendly systems designed to work within the often-demanding environments in which they operate. AI tools must adapt to limitations in electricity, connectivity and infrastructure while supporting—not replacing—human roles that bring empathy, flexibility and trust into the equation.

Cultural awareness is also vital in how AI is received and applied. From translation difficulties to misunderstandings rooted in social norms, it is clear that AI systems must be trained to understand and respect the cultural contexts in which humanitarian work takes place. Language-processing capabilities need to be refined to reflect local expressions, idioms and meanings, and system design must ensure inclusivity and sensitivity to diverse cultural realities.

Building trust in AI systems will, ultimately, depend on how transparent, accurate and supportive they prove to be. Embedding human oversight and decision validation into AI processes is essential, especially during moments of high stress when stakes are high. Moreover, information systems must be refined to avoid overload and ensure that decision makers can access the most relevant data when time is limited.

Table 3 presents a consolidated overview of the central themes that emerged from the analysis, highlighting the potential contributions and the ongoing challenges associated with integrating AI into humanitarian logistics.

Figure 3 translates the evidence gathered from the interviews into a simple theoretical formulation that explains how AI becomes genuinely useful in humanitarian logistics. At the center is the core idea of contextually adaptive human–AI augmentation. For example, practitioners do not "install AI" once, but they continually align modest AI capabilities with human judgment as situations evolve. This is particularly true because AI adds more value in planning and preparedness than in fast-moving emergency response where experienced intuition still dominates. The improvement loop begins by assessing contextual and infrastructural constraints (like, for instance, uneven or incomplete data, fragmented systems, connectivity and resource limits). These elements determine what kind of augmentation is feasible. We then move to governing for trust and ethics, putting in place validation checks, privacy/compliance routines and accountability measures that convert raw technical promise into something humanitarian logisticians feel safe to rely on. Next comes embedding with human and cultural mediation. Key elements here include, among others, addressing attitudes and resistance, tailoring language and interfaces, framing tools explicitly as supports (not replacements) for professional expertise and building skills so people actually adopt and continue using the systems. Finally, organizations focus on scaling through AI opportunity and network enablement. In particular, linking tools across agencies, improving interoperability and shared standards and leveraging collaborative networks are all crucial elements so that localized gains become system-level coordination improvements. Arguably, when scaling exposes new data gaps, governance questions or cultural fit issues, teams circle back to reassess constraints and begin another refinement loop (so improvement is iterative rather than linear).

Table 3. Thematic synthesis of key insights into AI integration in humanitarian logistics.

No.	Emerging Theme	Description
1.	Evolving AI's role in humanitarian work	Exploring how AI contributes to smarter planning, improved coordination and faster decisions while facing real-world limitations.
2.	Obstacles to embracing AI	Identifying practical and organizational obstacles, such as limited training, constrained budgets and hesitation to shift away from familiar systems.
3.	Strengthening collaborative networks	Emphasizing the need for stronger alliances among agencies, often complicated by politics, culture and incompatible technologies.
4.	AI's operational boundaries	Highlighting the reduced effectiveness of AI during time-sensitive emergencies, when reliable data are scarce and human judgment takes precedence.
5.	Ethical and privacy imperatives	Addressing the critical need for secure data practices, compliance with regulations and awareness of AI's environmental footprint.
6.	Human attitudes toward technological change	Recognizing emotional and professional concerns among staff, which must be addressed through meaningful involvement and skill-building.
7.	Adapting AI for challenging environments	Designing solutions that function reliably in areas where connectivity, power and infrastructure are unpredictable or limited.
8.	Improving data foundations	Addressing inconsistencies in data collection, volume and accuracy issues and preventing system overload during emergencies.
9.	Cultivating confidence in AI outputs	Ensuring that human validation remains central to decisions supported by AI to reduce the risks of flawed or biased recommendations.
10.	Understanding cultural and linguistic contexts	Promoting respectful and accurate communication across diverse communities, supported by culturally aware and multilingual AI systems.
11.	Bridging technological gaps across systems	Focusing on creating shared standards and systems to allow smooth exchange of information and broader AI adoption.
12.	Harmonizing automation with human insight	Striking a balance between technological support and the irreplaceable value of empathy, flexibility and human-led decision making.

Based on this analysis, we could argue that the proposed theoretical formulation makes the following five integrated claims: (1) better basics expand what AI can do (context conditions utility); (2) robust governance turns capability into trusted adoption; (3) phase context shapes where impact is highest; (4) interoperability spreads benefit outward; and (5) human/cultural mediation shapes both trust and sustained use.

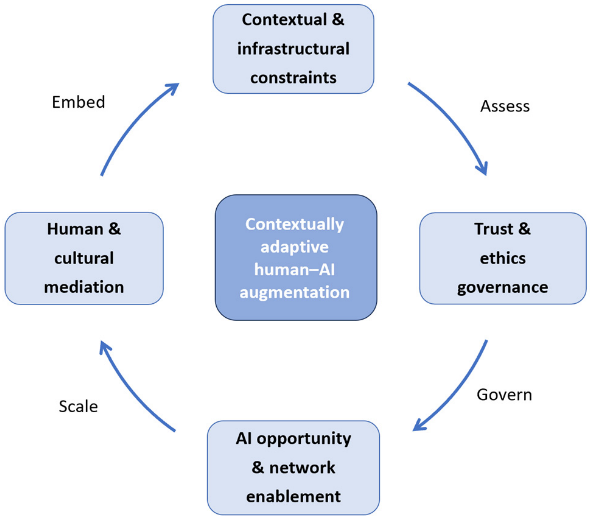

Figure 3. Theoretical framework: iterative human–AI augmentation cycle for humanitarian coordination.

5. Discussion

The integration of AI into humanitarian logistics presents a dynamic yet intricate landscape in which several opportunities coexist along with context-specific challenges. The empirical evidence and the relevant insights drawn from interviews with the logistics professionals reveal that while AI offers substantial promise in enhancing efficiency, improving coordination and supporting more informed decision making in the humanitarian sector, its successful adoption is far from straightforward. In particular, the complexity lies not only in the technology itself but also in how AI interferes with human behavior, ethical responsibilities and overall organizational structures. In addition, the process of implementing AI in this field must be viewed as a multifaceted task, where progress in one area depends heavily on developments in others. Such implementation approaches must be accompanied by investment in human capabilities, especially equipping personnel with the skills and confidence to engage with AI tools in a meaningful way. Also, reducing resistance to change depends largely on how empowered people feel within this transition.

Establishing confidence among stakeholders also calls for a strong dedication to moral integrity and effective data security policies. Especially in settings where data are sensitive and crucial for humanitarian logistics operations, privacy and security are absolutely vital. Any AI system meant for humanitarian use, at the same time, has to be sensitive to political subtleties and cultural variety. Without this sensitivity, even the most sophisticated AI instruments might not be accepted or resonate in particular local settings. No less crucial are the data, the fundamental building blocks upon which AI relies upon. Production of valuable outputs and supporting timely, evidence-based decisions depends on consistent, high-quality information and sound data management techniques. Without this, even carefully orchestrated AI systems could find it difficult to operate as intended. Therefore, understanding the interconnected nature of these factors is the first step toward building an approach that supports meaningful integration of AI in humanitarian settings. Technology has to fit the institutional reality of humanitarian logistics, as well as the social one. Only by taking these factors into account and developing a holistic approach can plans be created that are both sustainable and pragmatic, thus enabling AI to serve as a tool that strengthens humanitarian efforts.

5.1. Comparative Analysis

Analyzing the role and/or difficulties of AI adoption in humanitarian logistics, a comparative analysis of the empirical findings from both the expert interviews and the reviewed literature identifies a number of areas of agreement, as well as significant differences. For example, interviewees frequently underlined in their responses the importance of human experience in decision making, especially in situations characterized by disjointed data systems, technological constraints and cultural complexity. Despite the availability of digital tools, resource limitations and unreliable data streams frequently force field operations to rely upon manual techniques and human judgment. This practical dependence on human experience is consistent with research showing that, particularly in settings with limited available data, it is important to strike a balance between human intuition and AI-driven insights [15,33]. However, interviewees considered this balance as a persistent structural reality, particularly in low-infrastructure settings, whereas academic sources frequently frame it as a transitional issue, portraying a future dominated by automated intelligence.

Data access is identified as a fundamental challenge in both the literature and the interviews. Due to data overload, untrained staff and infrastructure failures, interviewees noted that it is nearly impossible to verify and act on data in real-time during emergencies. This is in line with the literature [8,19] that acknowledges the significant constraints that come with fragmentation, quality problems and a lack of data in humanitarian settings. However, academic literature frequently emphasizes technical solutions like big data architectures and AI-driven analytics. On the other hand, practitioners emphasized that advancements necessitate investments in organizational capability and cultural adjustment to data systems in addition to technology. Lastly, both groups point to volume management and data quality as critical issues. In particular, respondents expressed concern that biased, out-of-date or defective data could mislead AI systems and jeopardize results. These empirical finding align with the literature [36,40]. Furthermore, they pointed out that too much data without sufficient filtering systems can impede rather than aid in decision making. Although these risks are acknowledged in the literature, the practical difficulty of data triage in field settings is frequently understated or even misunderstood.

Although approached from different perspectives, both the literature and empirical evidence point to effective coordination as a fundamental component of humanitarian logistics systems. In order to facilitate coordination, interviewees emphasized the significance of trust, interagency relationships and the socio-political context. Especially, they emphasized that political meddling, inconsistent protocols and reluctance to share data frequently limit coordination, even in the presence of sophisticated AI tools. Similar to this, Trusilo and Danks [37] and Rodríguez-Espíndola et al. [27] agree that although AI can improve operational transparency and situational awareness, its efficacy depends on pre-existing frameworks for cooperation and data-sharing agreements among key participants. However, the interviews with the experts have highlighted the relational and institutional realities that condition such integration, whereas the scientific literature tends to focus more on systems-level integration frameworks.

Arguably, there is a general sense of optimism with respect to AI's ability to enhance resource allocation, forecasting and logistical efficiency. The interviewees emphasized real-world applications of AI in real-time language translation, route optimization and warehouse management. Such applications are in line with previous research [8,24,29], which shows how AI tools can improve agility and reduce delays in humanitarian supply chains. Additionally, the interviews' reports of the application of AI for anticipatory planning and predictive simulations align with other findings from the literature [19,28]. However, practitioners emphasized that while literature frequently assumes broader, phase-independent applicability, these benefits are most realistically achieved during preparedness phases, when stable conditions allow for deeper analysis.

The ethical dangers of using AI in humanitarian contexts are the subject of a significant convergence. Concerns raised by interviewees included environmental costs, beneficiary trust, data security and adherence to changing legal frameworks (such as the EU AI Act). These are in line with the academic focus on human rights, algorithmic bias and the necessity of strong governance [35,36,38]. However, practitioners expressed immediate concerns about operational risk, donor skepticism and community resistance, especially highlighting a disconnect between abstract ethics and practical accountability. On the other hand, the literature examines these issues within theoretical or policy-driven frameworks.

Assumptions regarding organizational capacity represent a major difference. Although scalable AI frameworks that are adaptable to different settings are frequently proposed in academic studies [27,30], interviewees questioned whether such models would be applicable to smaller organizations operating in environments with limited resources. In particular, they highlighted that usability problems, a lack of digital literacy and infrastructure deficiencies (such as connectivity and electricity) were major barriers to the adoption of AI. Additionally, they emphasized the significance of inclusive, confidence-boosting training to prevent alienating seasoned staff, a detail that is frequently overlooked in the academic literature.

The significance of developing AI systems that honor cultural diversity and promote inclusivity is acknowledged by both academic and empirical evidence. The credibility and efficacy of AI systems could be undermined by mistranslations, insensitivity to local customs and a lack of community input, according to interviewees. This supports the assertions made in the academic literature [36,38] that AI models must incorporate social nuance and contextual intelligence. However, field practitioners have emphasized direct engagement, iterative feedback and local partnerships as essential components for inclusive AI deployment in humanitarian logistics, whereas academic literature typically concentrates on principle-based frameworks for cultural adaptation.

Last but not least, beyond data security and integrity, heavy reliance on AI-enabled information systems widens the attack surface in the humanitarian logistics operations. For example, logistics platforms can be disrupted by malware and ransomware and/or denial-of-service attacks and supply-chain compromises. It should also be noted that AI systems are also vulnerable to failure modes such as algorithmic bias, data poisoning, model evasion and hallucinations that can misinform field decisions. In conflict settings, these risks are amplified by deliberate attempts by combatants or criminal actors to degrade, delay or even divert aid by targeting organizational networks and data flows. Mitigation, therefore, all these critical issues requires defense-in-depth (regular backups, encryption, access controls, monitoring and tested incident-response/continuity plans), human-in-the-loop verification of AI outputs with explicit uncertainty calibration and resilient operations (redundant/offline workflows and paper-based contingencies).

5.2. Synthesis of Findings

The process of incorporating AI into humanitarian logistics should not be considered a simple or linear approach. Rather, it expresses itself as a multi-layered, intricate process that necessitates a thorough comprehension of the interactions between different organizational, technological and human components. Drawing directly from the main research questions and the reflections of logisticians/experts, the insights acquired during the analysis describes a clearer picture of the practical realities that influence this transition.

5.2.1. How Decisions and Coordination Are Handled in Humanitarian Logistics (RQ1)

Humanitarian logistics frequently operates in highly stressful and unpredictable environments. In these situations, data are often inadequate, erratic or change too quickly to be useful right away. Decision making still heavily depends on professional networks and individual judgment, according to logistics professionals interviewed for this article. This is not just a matter of habit; it is the result of persistent issues like the lack of standardized data practices, restricted access to dependable technology and the additional complexity of linguistic diversity across operational contexts. Due to a lack of training and a reluctance to adopt new systems, digital tools are frequently underutilized even when they are available. Unless intentional efforts are made to develop organizational readiness for change and build technical capacity, these factors will continue to reinforce a reliance on experience rather than data. In addition, things are made more difficult by the urgency of disaster response. Despite the absence of precise or current information, important decisions frequently need to be made quickly. Several stressors were mentioned by interviewees, such as overworked staff, inadequate staffing and more general issues like political unrest. Because of this, field operations usually generate vast amounts of unstructured, inadequately processed data that hardly ever result in insightful, useful information. Experienced logisticians are frequently the primary conduit for prompt decisions in such high-pressure settings. Investing in reliable data systems that are made to swiftly gather, filter and process information would greatly improve the caliber of response operations and provide much-needed assistance to those on the ground.

Coordination is another crucial aspect of humanitarian logistics, especially when it comes to different actors like local communities, private partners, NGOs and government agencies. However, maintaining consistent cooperation is still one of the hardest things to do. Attempts to prevent duplication and make the most of scarce resources are still hampered by political agendas, cultural misinterpretations and a lack of common data standards. Even though the majority of stakeholders agree that open communication and transparency are crucial, progress is usually hampered by competing institutional priorities and worries about data confidentiality. Establishing coordination systems that promote regular, courteous communication and foster mutual trust is the way to go.

The framework directly addresses underutilization barriers—such as limited training, organizational skepticism and resistance to change, all identified through our empirical data. By emphasizing modular, human-in-the-loop decision support in the preparedness and mitigation phases, the model aligns with operational realities that allow more time for training and trust building. Transparency mechanisms (e.g., uncertainty flags and data quality indicators) and roles for expert validation are designed to foster acceptance. Furthermore, the inclusion of participatory co-design and iterative feedback loops functions as a built-in change-management strategy, enhancing the model's suitability within constrained, skeptical environments.

5.2.2. How AI Can Help Improve Planning and Coordination in Supply Chains (RQ2)

Although AI presents significant potential to improve humanitarian logistics, especially in the areas of supply-chain management, coordination and planning, still, its actual usage for humanitarian purposes bears significant challenges. These settings are frequently characterized by a lack of data, quick changes and the requirement for quick decisions; therefore, it is crucial to modify AI tools to fit these uncertain circumstances. AI works best in the early phases of humanitarian efforts, particularly in preparedness and mitigation. Usually, these stages provide time for comprehensive data collection and in-depth analysis. AI can assist with planning, forecast possible disruptions and direct the strategic allocation of resources with this basis. On the other hand, AI systems face a more challenging task during the response phase. Real-time decisions must be made quickly, frequently in the face of changing information and ambiguous conditions. These situations highlight the drawbacks of depending only on automated tools. In order to interpret AI-generated insights and modify strategies as circumstances change, the advice of seasoned professionals is still essential. This emphasizes how crucial it is to combine technological assistance with human knowledge rather than relying solely on AI to function.

AI's application in humanitarian logistics must be in line with the unique requirements of every stage of operations in order to optimize its value. AI can provide thorough forecasts and encourage proactive planning during periods of relative calm. Its function should change from directing to assisting in decision making in emergency situations. A well-rounded strategy that honors both AI's analytical prowess and human judgment's flexibility guarantees that operations remain effective without sacrificing the responsiveness needed in emergency situations.

The framework acknowledges that political interference and cultural sensitivities cannot be reliably inferred or managed by AI alone. Rather than positioning AI as a tool for "guessing" such complexities, the approach emphasizes assistive roles (such as information triage and scenario structuring) within a human-in-the-loop model. Expert insights stressed the need for human oversight, contextual vetting and culturally informed judgment. Accordingly, the framework delineates clear boundaries for algorithmic support, including mechanisms for uncertainty communication and escalation, ensuring that decisions remain anchored in local knowledge and ethical scrutiny.

5.2.3. What Makes It Hard to Use AI in Humanitarian Logistics (RQ3)

The challenge of integrating AI into humanitarian logistics is complex and influenced by organizational barriers, cultural norms and technical constraints. Building trust, reshaping systems and aligning with operational, ethical and legal frameworks are all necessary steps in the process, which goes beyond merely introducing a new tool. According to interviews with experts in the field, although AI has many potential advantages, its application is frequently limited by a number of interrelated obstacles.

The challenge of integrating AI with ethical norms and legal requirements is a major concern. Stakeholders are still wary, especially when AI systems behave in opaque ways. Both donors and recipients might doubt the technology's dependability, particularly if results fall short of expectations. Bias, privacy and accountability concerns are widespread, particularly in situations where lives are on the line. In these situations, establishing trust requires open dialogue about AI's limitations and potential hazards as well as transparent communication about what AI can actually accomplish. Establishing strong data protection procedures and making sure regulations are followed are important, but they are insufficient on their own. Any AI-driven solution must be accompanied by human oversight and transparent decision-making procedures in order to uphold accountability and promote trust.

Additional challenges in many organizations are staff resistance and low levels of digital literacy. Particularly if they feel left out of the design and implementation process, teams may be uninformed about AI tools or doubt their value. Because of this, inclusive engagement and training are crucial. Employees must comprehend how AI systems operate, evaluate their results and incorporate them into daily tasks without worrying about being replaced. In order to facilitate adoption and encourage long-term use, user-friendly design that is in line with organizational capacity is essential.

Infrastructure and technological issues also play a major role in the conversation. The unreliability of internet and electricity in many humanitarian settings makes it challenging for AI systems to operate efficiently. In order for tools to function in low-resource environments, lightweight and context-sensitive technologies must be developed. Adoption and effective use are significantly higher for systems created with these realities in mind.

Financial constraints only make things more difficult. Particularly smaller businesses frequently lack the resources necessary to hire qualified staff or invest in AI infrastructure.

Due to these limitations, it is challenging to obtain the technical capability and high-quality data needed for a successful deployment. Donor concerns can be allayed and investment justified by proving AI's cost-effectiveness in terms of better results and long-term savings. Frequent updates and open reporting on AI's impact and efficiency contributions can boost trust and motivate partners and donors to keep supporting the technology.

AI can also help stakeholders coordinate better, but its effectiveness hinges on overcoming a number of technological and social obstacles. Collaboration may be hampered by linguistic, cultural and operational differences, especially in the absence of a common framework for data exchange. It is crucial to create systems that respect cultural differences and transcend organizational boundaries. Improved communication and collaboration among various actors can be facilitated by culturally sensitive design, adaptable implementation and established data standards.

Any successful AI system is built on the foundation of data management and quality. While too much information can overwhelm users and cause them to put off making decisions, inaccurate or incomplete data can jeopardize outputs. More data collection is not enough; it also needs to be precise, well-structured and pertinent to the choices being made. Information must be filtered and prioritized by systems so that teams can act more swiftly and confidently. Our findings explicitly acknowledge data unreliability as a core challenge in humanitarian contexts. Rather than assuming clean datasets or advocating for fully autonomous systems, the proposed framework is positioned as a human-in-the-loop decision-support model. It emphasizes data quality screening, uncertainty awareness, and the integration of ethical, legal and contextual filters. As such, its contribution lies in augmenting (not replacing) human decision making under conditions of imperfect or incomplete data.

5.3. Implications for Researchers, Practitioners and Policy Makers

Researchers must pivot from lab-grade benchmarks to field-first experimentation, stress-testing models against the realities of humanitarian work (especially sparse and noisy data, intermittent power and connectivity and political sensitivities). That means exploring transfer- or federated-learning so smaller NGOs can adapt global models without surrendering data sovereignty and running longitudinal case studies that follow a tool across preparedness, response and recovery to see where performance drifts, when human intuition overrides machine advice and how continual re-training is triggered by shifting ground conditions.

A second agenda is to rigorously measure human–AI teaming rather than just algorithmic accuracy. Mixed-methods protocols that pair log-file analytics (decision latency and override frequency) with cognitive or ethnographic interviews can expose how practitioners actually trust, tweak or discard recommendations. Parallel "ethics-in-use" research should track how broad principles (EU AI Act) turn into daily routines (model-validation checklists, audit trails, data-sharing MOUs and environmental-impact reports) and interrogate trade-offs between accuracy and privacy, deployment speed and environmental footprint or global model power and local legitimacy. Interdisciplinary teams spanning law, policy, computer science and field logistics can turn those insights into actionable governance blueprints.

Practitioners should start with disciplined data hygiene and human-centered rollouts rather than chasing flashy tools. Standardize a minimal set of fields (e.g., location, timestamp, inventory ID and confidence score) and a lightweight collection protocol that volunteers can follow under low power and bandwidth. It is critical to keep human judgment in the loop so results remain aligned with humanitarian values and on-the-ground realities. Practitioners should run workshops where users can analyze and tweak models, then co-author guidelines for when to override them. In addition, logisticians should treat transparency routines as operational safeguards, especially by maintain a living "model passport" (purpose, data, last update and contact) and quick-look dashboards on data freshness and blind spots.

Policy makers should turn interoperability and governance clarity into funding conditions rather than aspirations. In particular, they should make open humanitarian data schemas, machine-readable metadata and reciprocal data-sharing MOUs (with privacy and safeguarding clauses) non-negotiable in grants and framework agreements, thus tying disbursements to concrete milestones like common inventory taxonomies or real-time stock APIs. They should also treat capacity building and sustainability as core infrastructure. Policy makers should also fund digital-skills training, regional AI service hubs and low-resource language corpora so smaller local groups are not left data-poor. Clear standards plus inclusive, sustainable resourcing can build trusted data ecosystems that deliver faster, fairer and more efficient relief.

5.4. Limitations and Future Research

This study provides a useful foundation for comprehending how AI can aid in humanitarian logistics coordination and decision making. But it should be recognized that it has limitations. The results may not accurately reflect the varied realities of humanitarian operations across various organizations, geographical areas or crisis situations because they were derived from a comparatively small sample of logistics professionals. The degree to which these insights are applicable more widely is inevitably constrained by the complexity and unpredictability of humanitarian logistics, where circumstances change quickly and conditions vary greatly. The findings' applicability beyond the cases studied can be influenced by a number of factors, including the type of disaster, organizational mandates, political context and cultural environment. However, GT poses several challenges. Defining and measuring saturation—the point at which no new insights emerge—can be difficult [49]. Managing and interpreting large datasets also requires careful organization and cognitive effort [43,50]. Within this context, several studies [45,51,52] highlight the need for theoretical grounding and philosophical clarity, while Timonen et al. [53] and Chun Tie et al. [46] offer guidance for navigating methodological complexity. This study is based on five purposive elite interviews and is, therefore, exploratory. We do not assert theoretical saturation; instead, we report preliminary propositions grounded in patterns observed across these interviews. Different experts or organizations might offer alternative interpretations, so the findings should be read as provisional and of limited transferability.

Future research could go in a number of encouraging directions. For example, future work should broaden and diversify the sample, include frontline perspectives and triangulate with complementary evidence (e.g., operational records, case studies or surveys) to assess the robustness and scope of the themes identified. A more thorough grasp of how AI works over time and in diverse contexts may be possible with the help of long-term case studies and comparative analyses across different humanitarian operations. This would make it clearer how its function varies from preparedness to recovery and which instruments are most useful under particular circumstances. Which systems and tactics are worthwhile expanding or modifying for different cultural and infrastructure contexts could also be suggested by comparative studies. Evaluating the true effects of AI on humanitarian logistics is equally crucial. Stronger evidence to direct practitioners and donors would come from measuring results in terms of cost-effectiveness, efficiency or enhancements in service delivery. Determining which AI applications merit further investment and growth may be aided by structured cost-benefit analyses. At the same time, research on the perceptions of stakeholders, such as donors, recipients and local government, may shed light on how to establish and preserve trust, as well as how to increase accountability and transparency, in AI-supported operations.

Another important topic for additional research will be capacity building. Finding the best training methods for various humanitarian worker groups may help close the knowledge gap and reduce reluctance to adopt new technologies. Future research could examine which forms of instruction—workshops, practical experience or digital toolkits—best foster competence and confidence when utilizing AI systems. There is also room to look at how AI and human expertise interact in various operational roles and how this relationship can be managed to preserve flexibility, ethical awareness and prompt decision making in high-pressure situations. The impact of regulatory and policy frameworks is another crucial area that requires further research. Gaining insight into how donor guidelines, governmental regulations and international standards influence organizational behavior may help develop new strategies for promoting the responsible application of AI. Future studies could pinpoint the incentives and policy instruments that promote cooperation, facilitate data-sharing practices that respect moral principles and increase effectiveness and impact.

Further empirical research is also required to validate and test the patterns identified here. The field of humanitarian logistics is extremely complex and more thorough, context-specific research is needed to make generalizable conclusions. This complexity must be taken into account in future research, particularly with regard to the operational, political and cultural factors that influence the integration and application of AI. This study's main concern was data-related, specifically with regard to data scarcity, poor quality and the possibility of information overload. Notwithstanding the significance of these issues, there is currently a dearth of hard data regarding the best ways to methodically enhance data management, validation and collection in humanitarian contexts. It will take innovative methodology, significant investments in workforce development and technology to close these gaps. Even though the study acknowledged ethical issues, more research is required to go beyond broad debates and create useful guidelines that take accountability, privacy and fairness into account. It is still difficult to translate ethical theory into practical application, especially in humanitarian settings where openness and trust are crucial.

6. Conclusions

Humanitarian logistics has a great chance to change the way it makes decisions and coordinates, especially when it comes to tackling enduring issues like resource allocation, response time and overall operational effectiveness. According to this study, AI can help stakeholders coordinate in real time, predict the effects of disasters and greatly enhance supply-chain performance. However, overcoming a number of enduring obstacles is necessary to realize these advantages. These include restrictions on the availability and quality of data, technological infrastructure, moral dilemmas, organizational resistance and cultural contexts.

One of the most significant findings is that AI works best when it complements human expertise rather than replaces it. The flexibility and discernment of seasoned staff members continue to be crucial in disaster scenarios, where uncertainty and quick change are commonplace. Although AI can help by offering insightful information and predictive analysis, its results need human interpretation and adaptability.

The study highlights the necessity of a thorough and well-coordinated strategy to accomplish significant AI integration. This entails integrating ethical safeguards into practice, encouraging organizational change that fosters innovation and coordinating technological advancement with capacity-building initiatives. Humanitarian organizations can start to realize AI's potential as a tool that improves human capability by addressing these interrelated components. AI becomes a powerful supplement to conventional techniques, enhancing their speed, accuracy and scope rather than taking their place.

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Abbreviations

The following abbreviations are used in this manuscript:

AI	Artificial intelligence
RQ	Research question

Appendix A

Table A1. Questionnaire for the semi-structured interviews.

Main Question 1: How do you currently approach decision-making and coordination in humanitarian logistics within operations?
Sub-question 1.1.: What are the main challenges you face, especially in data collection and analysis, when making decisions in real-time during disaster-response efforts?
Sub-question 1.2.: How do you manage and coordinate logistics across multiple stakeholders, including local governments, NGOs and international partners?
Main Question 2: How can AI assist in optimizing humanitarian logistics networks, specifically in the planning and coordination of supply chains?
Sub-question 2.1.: How can AI optimize logistics networks, distribution efficiency, inventory management and resource allocation in humanitarian operations, and what are the potential benefits of simulating real-time "what-if" scenarios for dynamic route planning?
Sub-question 2.2: How can AI improve coordination and decision-making, in different phases of humanitarian logistics, and which phase—mitigation, preparedness, response, or recovery—would benefit the most from AI-driven solutions?
Main Question 3: How do you perceive the possible challenges of integrating AI into humanitarian logistics operations?
Sub-question 3.1.: What challenges or concerns might arise when implementing AI in IFRC's logistics operations, particularly with regard to technology adoption, staff training, and ensuring real-time decision-making in fast-paced disaster response scenarios with limited information or overloaded systems?
Sub-question 3.2.: How do you perceive the possible challenges of integrating AI particularly in terms of enhancing coordination with other humanitarian actors (NGOs, governments, and private sector partners), and how difficult can AI be integrated with human intelligence (HI) to account for cultural nuances and emotional understanding in cross-cultural contexts?

The questions listed above represent the general themes explored during the semi-structured interviews. Depending on each participant's role, background, and how the conversation evolved, further or follow-up questions were sometimes introduced to explore specific topics in greater depth.

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