



Resilience in Humanitarian Supply Chains: A Review of AI-Driven Big Data Analytics Applications

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Abstract

Humanitarian supply chains face unprecedented challenges due to escalating global crises, with approximately 279 million people requiring assistance in 2022 alone. The traditional reactive approaches to humanitarian logistics are becoming ineffective at managing the increasingly complex and large-scale disaster responses. In this paper, we analyzed the coupling of artificial intelligence (AI) and big data analytics (BDA) as transformative levers for improving the resilience of humanitarian supply chain operations. With a focus on disaster forecasting, resource allocation, and stakeholder coordination in humanitarian contexts, we study how AI-driven predictive modelling and BDA will change the narrative. This paper identified several significant implementation barriers, including data quality issues, infrastructure limitations, and ethical concerns related to algorithmic bias and privacy. Theoretical frameworks for using AI-BDA for humanitarian logistics exist, but examples of real-world effectiveness are limited. The paper aims to fill this research gap by evaluating some AI-BDA techniques focusing on time-series forecasting, early warning systems, logistic optimization, and real-time monitoring in humanitarian settings and offering evidence-based recommendations for implementation. The strategic integration of these technologies may be leveraged to transition from the reactive to the more proactive humanitarian response models, thereby improving aid delivery efficiency by up to 30% during a crisis. We conclude with practical guidelines for humanitarian organizations exploring the use of AI-BDA capacity building and appropriate data governance frameworks for AI-BDA adoption.

Keywords: Humanitarianism; Resilience; Humanitarian Supply Chain; Big Data; Artificial Intelligence.

1. Introduction

Henri Dunant is known as a pioneer of organised humanitarian work, establishing the International Red Cross and Red Crescent Movements in 1859 [1]. Humanitarian organisations are guided by principles of humanity, neutrality, impartiality, and independence and focus on the core objectives of disaster response, human rights advocacy, and relief services [2]. The UN General Assembly legally established these principles in 1991 and 2004, making them

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the basis of modern humanitarian action. Henri Dunant pioneered organised humanitarian work with the founding of the International Red Cross and Red Crescent in 1859 [1]. Humanitarian organisations operate on the principles of humanity, neutrality, impartiality, and independence, formally established by the UN General Assembly in 1991 and 2004 [2]. These organisations now include governments, private entities, and NGOs. With increasing global crises, such as armed conflicts, climate change, and economic instability, humanitarian operations have grown more complex, requiring improved coordination and technological advancement [3-4]. As a result, approximately 279 million people required humanitarian assistance in 2022, a number expected to grow as crises intensify [5]. To meet these escalating demands, humanitarian supply chains must become more resilient and adaptable. Integrating Artificial Intelligence (AI) and Big Data Analytics (BDA) offers a transformative solution for enhancing humanitarian supply chain operations (HSCO) [6-7]. HSCOs are essential for delivering critical aid during emergencies such as natural disasters, pandemics, and conflicts [8-9]. However, these operations are often unpredictable and vulnerable, underscoring the need for smarter, data-driven strategies to improve resource allocation, decision-making, and overall system resilience [10-11]. Current technologies and logistical strategies have addressed some of these issues but struggle under the pressure of large-scale, fast-moving crises [12-13]. Traditional humanitarian approaches tend to be reactive, responding after crises unfold. AI and BDA, however, enable proactive strategies through predictive modelling, advanced data analysis, and real-time decision-making support [14, 8, 11]. AI technologies, including machine learning, natural language processing, and computer vision, mimic human intelligence to analyse vast datasets and produce actionable insights [16-17]. These capabilities can forecast disaster impacts, improve preparedness, optimise delivery routes, and allocate resources where most needed [18-20]. BDA complements AI by integrating diverse data sources (e.g., satellite images, social media) to enhance situational awareness and detect emerging risks for faster intervention [21-24]. Together, AI and BDA can fundamentally transform humanitarian logistics. AI enables predictive analytics, while BDA provides data-driven insights for strategic decisions [8, 23-25]. Despite their potential, the implementation of AI and BDA in HSCO is still limited due to data quality issues, infrastructure constraints, and security concerns [26-29]. Moreover, research on their use in humanitarian operations remains scarce and inconclusive [8, 30-32]. This study aims to address this gap by examining effective AI-BDA applications in humanitarian logistics and offering evidence-based recommendations for improved disaster response.

2. Humanitarian Supply Chain Resilience

Humanitarian Supply Chain Resilience (HSCR) has quickly become a significant concept in disaster response and relief. It includes the capacity to prevent, plan for, deal with, and lessen the effect of interruptions without interruption of essential operations [33]. More often, disasters are frequent, diverse and more severe than before, considering the geopolitical contexts; hence, the importance of HSCR puts into centrality saving lives when delivering aid to affected populations [34-35]. Hence, the concept of HSCR goes beyond the notion of solidity or the capacity to cope with shocks. It is a dynamic capability that results in humanitarian organizations being able to adapt to their context through learning and development [28]. This is particularly important because humanitarian operations often occur in unpredictable, fluid, and dynamic environments. For instance, Ivanov and Dolgui [36] note the flexibility and adaptability of humanitarian supply chains in maneuvering their operations during the COVID-19 crisis.

2.1. Identification of Criteria and Indicators

Prior studies reviewed in this paper have outlined the multiple factors in developing resilience in humanitarian supply chains. It has been established due to pre-assessment [37], various stakeholders [38], strategic management [28], responsiveness [39], risk management [40], and material support [41]. Prior studies have identified multiple factors that contribute to resilience in humanitarian supply chains (HSCs), including pre-assessment [37], stakeholder involvement [38], strategic management [28], responsiveness [39], risk management [40], and material support [41]. Need assessment is a critical component, involving rapid identification of the needs in disaster-affected areas and evaluating the capacity of the supply chain. As emphasized by Nagurney and Qiang [42], demand identification is crucial, though the unpredictable and dynamic nature of disasters requires prior estimation through risk assessment models and timely information dissemination [43]. Transportation analysis is also essential in pre-assessment. Innovative methods like drone usage have significantly improved rescue efficiency by gathering data on transport routes [44]. Assessing available resources in advance enhances HSC resilience [45], and resource sharing has been found to support sustainability in the supply chain [46]. Key stakeholders in HSCs include government agencies, enterprises, humanitarian organizations, and volunteers [42]. Dubey et al. [25] highlighted that transparency and trust-building among actors are critical for robust operations. Lack of collaboration and trust often hampers effectiveness [24]. For example, in the Chennai flood case, John et al. [47] linked information exchange directly to improved coordination. Strategic management, including effective planning, inspection, and logistics management, is vital [28]. Torabi et al. [48] argued that strategic planning is the foundation of sound decision-making. Sustainable management involves overarching strategies adaptable to various disaster phases [49]. Proper verification of supply origins and donated items is also emphasized [50]. Nayak and Choudhary [51] demonstrated that streamlined logistics significantly enhance HSC effectiveness. Responsiveness in HSCs requires flexibility, adaptability, and speed [52]. Technological tools enhance flexibility and sensitivity in disaster response [29], underscoring the importance of adaptive management strategies [53]. Reducing pipeline delays accelerates decision-making and improves overall efficiency [54]. Given the uncertainties of flood events, risk management is essential. It involves developing warning capabilities, risk awareness, and distributed power [55]. These measures minimize resource waste and improve efficiency [56]. Patil et al. [57] stressed that risk awareness should be cultivated among both responders and communities. In disrupted environments, distributed power is vital [45]. Resilience also depends on sufficient support such as big data, skilled personnel, and standardization [28, 58]. Artificial intelligence enhances resilience by improving decision-making [59]. Effective human resource management is also indispensable [60], while standardisation boosts material substitutability and system strength [61]. Table 1 presents a highlight of the efforts by humanitarian organisations to achieve resilience.

Table 1. Efforts by Humanitarian Organisations to Achieve Resilience

Item	Overview	
	<i>Humanitarian Efforts</i>	<i>Source</i>
HSCR1	Organisations quickly restore the flow of items with the help of AI-driven technologies.	[28, 57-58]
HSCR2	Information gathered using AI-driven technology helps organisations provide necessary relief materials during unexpected disruptions.	
HSCR3	Organisations maintain a buffer stock of essential relief items to tackle demand and supply uncertainties.	
HSCR4	Organisations quickly repair the damages caused to the fundamental property, schools, and other essential centres.	

3. Artificial Intelligence in the Humanitarian Supply Chain

Artificial Intelligence (AI) encompasses diverse fields such as machine intelligence, robotics, and computer vision, with the overarching goal of replicating human cognitive functions like decision-making, textual analysis, and image recognition [62-63]. AI's appeal lies in its potential to help build a more advanced society [64], and it is already making significant contributions across industries, including humanitarian supply chains. In humanitarian operations, AI plays a transformative role, particularly in needs assessment and demand forecasting, areas where traditional methods struggle due to crisis unpredictability [65-66]. Machine learning algorithms can process vast datasets, including satellite images, social media, and historical data, to forecast resource needs accurately [67]. For example, Rodríguez-Espíndola et al. [59] demonstrated how integrating AI with blockchain and 3D printing technologies can improve demand forecasting and resource allocation in disaster settings. AI is also instrumental in enhancing logistics and transportation. Intelligent routing algorithms can evaluate road conditions, security threats, and delivery urgency to determine optimal transport routes [68-70]. Masoumi et al. [71] proposed a method that minimises aid delivery time from temporary depots to affected regions. In addition, AI supports inventory control and resource customisation, ensuring essential supplies are pre-positioned where needed using real-time data [67, 72]. Beyond operations, AI fosters improved collaboration among humanitarian agencies by facilitating information sharing through multiple data streams, enhancing data quality and resource efficiency [73-74]. Moreover, AI tools like chatbots offer a new channel for engagement with affected populations, though concerns remain around data privacy and communication gaps [32]. Despite these benefits, the integration of AI into humanitarian supply chains faces several challenges. These include risks of cyber-attacks, lack of robust infrastructure, privacy concerns, and limited algorithmic transparency [75-76]. Scholars suggest potential solutions such as creating robust and continuous AI governance frameworks, assigning leadership roles specifically for AI oversight, and conducting long-term evaluations of AI's impact on humanitarian logistics [77-78]. With these measures, AI's full potential in improving humanitarian supply chains can be more safely and effectively realised.

4. Big Data Analytics (BDA) In Humanitarian Supply Chains

Big Data Analytics (BDA) is emerging as a promising research area in humanitarian operations, offering significant improvements in strategic and tactical decision-making within disaster relief supply chains [15, 29]. The increasing frequency and complexity of global emergencies, alongside rapid advancements in data collection, drive interest in BDA's application in humanitarian settings [29]. BDA involves gathering large volumes of data from diverse sources, such as satellite images, social media, sensors, and historical disaster records, and analyzing them to enhance decision-making and operational efficiency [45, 58, 79]. One primary application of BDA in humanitarian supply chains is demand forecasting and needs assessment [80]. Traditional needs assessments often rely on time-consuming manual surveys [81-82]. In contrast, BDA enables real-time, integrated analysis of various data streams, allowing for more accurate and timely assessments [83-84]. For example, Makker et al. [85] demonstrate how BDA utilises social media and satellite imagery to identify disaster impacts and prioritise response efforts. Another key application of BDA is in inventory control and supply chain management [86]. Humanitarian logistics often face the dual challenges of pre-positioning supplies while maintaining flexibility for unforeseen events. BDA helps optimise stockpiling and resource distribution by analysing historical data, current trends, and predictive models [87-88], enhancing resource use and reducing response times. Transportation and logistics planning also benefit significantly from BDA. By incorporating real-time data on road conditions, weather, and population movements, organisations can design dynamic and adaptive routing systems [89]. Li & Lv [30] highlight that BDA-based algorithms can adjust to on-ground changes, ensuring efficient and safe delivery routes. Despite these benefits, BDA adoption faces challenges including data quality, privacy concerns, and a need for

specialised technical expertise [90]. The chaotic nature of disaster environments further complicates data collection and analysis [91-92]. Addressing these issues requires collaboration among humanitarian actors, tech companies, and policymakers to develop ethical and practical BDA solutions. Looking forward, integrating BDA with emerging technologies like Artificial Intelligence (AI) and the Internet of Things (IoT) could further enhance the flexibility, resilience, and efficiency of humanitarian supply chains [11, 25].

5. Existing Techniques Of AI-BDA In Humanitarian Supply Chains

5.1. Time-Series Forecasting

Specifically, time-series forecasting is helpful in proper planning and devising ways to manage the resources in the humanitarian supply chains. Some of the proposed methods include fuzzy time series for disrupted supply chains [93], case-based reasoning for predicting the demand for emergency resources [80] and seasonal autoregressive integrated moving average (SARIMA) for medical inventory forecasting. Others are the online robust principal components analysis used with extended short-term memory networks for forecasting demand for a specific commodity [94] and probability distribution-based tools for natural disaster prediction [95]. These process-oriented and complex methods carefully analyze historical trends to arrive at highly detailed forecasts, allowing organizations to counteract market developments, adjust production calendars and manage inventories more effectively. Therefore, timely time-series forecasting reduces stockouts, fosters agile supply chain management frameworks and curtails excess inventory expenditures.

5.2. Early Warning Systems

Many contemporary humanitarian supply chains use complex algorithms that help predict the occurrence of a disaster and coordinate the distribution of supplies. Hasan et al. [96] used machine learning algorithms, Random Forest, and Gradient Boosting, which are more promising, with accuracy ranging from 86.7% in flood susceptibility prediction and 80% in flood risk classification. These systems help organisations stock and implement deployment plans before disasters occur.

5.3. Logistics Optimization

AI algorithms in logistics tend to improve delivery processes, making them more effective and affordable [97]. These models seek to move people and commodities in emergencies effectively and can involve heuristic solutions and multiple criteria decision-making [98]. As case studies suggest, evidence-based optimisation can inform policies and decisions affecting humanitarian work [99-100]. Studies by Wang et al. [101] and Serrato-Garcia et al. [102] note that mobile technology can assist in developing multi-objective decision-making models that integrate economic and social costs to help decision-makers.

5.4. Real-time Monitoring

AI helps in real-time monitoring of stocks and thus increases responsiveness in situations with instabilities [103], [104]. Some prior works have focused on the logistic management of monitoring systems in humanitarian SCs concerning the issues surrounding essential data gathering, control and display techniques in remote environments [105-106]. These systems seek to make available real-time information about resources, goods, equipment, and personnel [106]. Incorporating dynamic in-field data to enhance decision-making in disaster response [107]. For instance, RFID and Wi-Fi technologies have been used for real-time location tracking in humanitarian crisis response [108]. Table 2 below shows an overview of the various AI-BDA techniques implemented in humanitarian supply chains.

Table 2. Summary of the AI-BDA techniques implemented in humanitarian supply chains

Item	AI-BDA Techniques	Source
TSF1	Our organisation uses AI for demand prediction in humanitarian operations	[80, 93]
TSF2	We employ machine-learning algorithms for supply chain disruption forecasting.	
TSF3	Our organisation utilises predictive analytics for medical inventory management.	
EWS1	Our organisation employs machine learning for disaster risk prediction.	[96]
EWS2	We use AI-powered systems for flood susceptibility prediction.	
EWS3	Our early warning systems help pre-position supplies before disasters.	
LO1	Our organisation uses AI algorithms to optimise delivery routes during crises.	[97-98, 102],
LO2	We employ multi-objective optimisation models for resource allocation.	
LO3	Our organisation uses AI for transportation network optimisation.	
RTM1	Our organisation employs real-time tracking systems for supply visibility.	[105-106, 108]
RTM2	We use AI to monitor resource distribution in real time.	
RTM3	Our organisation utilises technology for real-time location tracking of humanitarian supplies.	

6. Case Studies of AI-BDA Integration in HSCS

Zouari et al. [109] examined the relationship between Supply chain resilience (SCR) and Supply chain (SC) digitalization. A sample was considered with 300 professionals working in the field of SCM, and the data was evaluated through factor analysis and structural equation modelling (SEM). SEM was used to examine the moderating role of the degree of digital maturity and SC digital tools on SCR. They discovered that the conversion of the business supply chain, with help from BDA and AI, leads to visibility throughout the chain because such technologies help acquire essential information concerning the environment and the status of operating assets. Building upon previous research, Belhadi et al. [110] examined the mediation roles of supply chain resilience (SCRes) and supply chain performance (SCP) between AI and the dynamism and uncertainty of the supply chain context. Thus, they defined the use of AI in the supply chain with the help of the organizational information processing theory (OIPT). This research employed structural equation modelling (SEM) to assess the validity and reliability of the developed framework. Survey data was gathered from 279 firms of varying sizes across different industries and countries. The research affirmed the propositions of the framework under analysis by presenting the practical outcomes pointing at the significant impact of AI on SCP through the augmentation of the related metrics and fostering SCRes. In a qualitative study, Modgil et al. [111] highlighted how organizations use AI and how they think about AI to give visibility, risk, sourcing and distribution capacities to improve supply chain vulnerability. The authors collected high-quality data through purposive sampling and semi-structured interviews with 35 professionals associated with the e-commerce supply chain sector. The authors employed open, axial and selective coding approaches to systematically categorize the data and infer the elements that make AI-enabled supply chain resilience. The study's findings underscore five novel domains that can lead to improved and robust

supply chain performance through the help of AI. Some of the key drivers for supply chain visibility are (1) transparency, (2) guaranteeing last-mile delivery, (3) delivering customized supply chain solutions to both upstream and downstream supply chain links, (4) managing the effects of disruption, and (5) enabling a flexible procurement model. According to Singh et al. [112], robust evidence has been provided to determine the status of AI/BDA on supply chain resilience. To achieve the study's objective, the authors built the methodology to extract helpful information from the literature studied and developed the Total Interpretive Structural Modelling (TISM) with the help of 44 supply chain professionals. The authors used a quantitative questionnaire and obtained 229 responses to test the model. With the analysis, a comprehensive and conceptual framework is developed. One of this study's significant findings is that supply chain analytics is requisite for supply chain resilience. The research findings support the hypothesis that the increased application of supply chain analytics has a positive and significant effect on the adaptability of demand forecasting to inventory management, enhancing the overall efficiency of supply chain networks. A valuable study in this context has been provided by Bag et al. [113], focusing on incorporating big data analytics in overcoming disruptions of supply chain systems in the COVID-19 process. The authors pointed out risks inherent in purchasing and supply chain management by establishing a hypothetical model to attain supply chain resilience through big data. The research team chose the samples from the automobile parts affiliated manufacturers' database in South Africa, which amounted to 375. The partial least squares structural equation modelling (PLS-SEM) technique was used to test the hypothetical model based on primary data from manufacturing industries. Big data analytics tools could be effectively applied to restore and increase supply chain resilience.

7. Conclusion

This paper highlights the potential for AI-driven Big Data Analytics to enhance humanitarian supply chain resilience. Global crises are becoming more frequent and complex, and traditional reactive approaches are increasingly unable to keep pace with growing demands for humanitarian assistance. Notably, the integration of AI and BDA is potentially effective in forecasting disasters, optimizing resource allocation, and coordinating among stakeholders. However, implementation succeeds only with the overcoming of serious challenges, including data quality issues, infrastructure deficiency, and ethical concerns (algorithm bias and privacy). To demonstrate actual world effectiveness, empirical studies have to be carried out to close the gap between theoretical framework and practical applications. Humanitarian organizations look forward to building technical capacity, developing data governance frameworks, and establishing collaborative partnerships to use AI-BDA technologies at their full potential. Policies should be created that further promote supportive regulations that support innovation and ethical considerations. Organizations can better support people trapped in crises by integrating AI and BDA solutions for humanitarian environments, moving from a reactive to a proactive stance and saving more lives. Future research should assess the tangible humanitarian impact of these technologies and identify best practices for safe and effective deployment in a variety of operational environments.

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Conflicts of Interest

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Ethical Approval and Consent to Participate

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References

- [1]. Shafiq, M., & Soratana, K. (2019). Humanitarian logistics and supply chain management: A qualitative study. *LogForum*, 15(1), 19–38.
- [2]. Rysaback-Smith, H. (2015). History and principles of humanitarian action. *Turkish Journal of Emergency Medicine*, 15(Suppl 1), 5–7.
- [3]. Ruth, N., Crispus, F., & Devis, A. (2024). The influence of media on humanitarian intervention: A case of South-Sudan Embassy. *Metropolitan Journal of Academic Multidisciplinary Research*, 3, 32–40.
- [4]. Scott, M., Bunce, M., & Wright, K. (2022). The influence of news coverage on humanitarian aid: The bureaucrats' perspective. *Journalism Studies*, 23(2), 167–186.
- [5]. United Nations. (2022). Record numbers of people need humanitarian assistance. *Humanitarian Affairs*.
- [6]. Rege, A. (2023). The impact of artificial intelligence on the supply chain in the era of data analytics. *International Journal of Computer Trends and Technology*, 71, 28–39.
- [7]. Smyth, C., Dennehy, D., Fosso Wamba, S., Scott, M., & Harfouche, A. (2024). Artificial intelligence and prescriptive analytics for supply chain resilience: A systematic literature review and research agenda. *International Journal of Production Research*, 1–25.
- [8]. Dubey, R., Bryde, D. J., Dwivedi, Y. K., Graham, G., & Foropon, C. (2022). Impact of artificial intelligence-driven big data analytics culture on agility and resilience in humanitarian supply chain: A practice-based view. *International Journal of Production Economics*, 250, 108618.
- [9]. Taleghani, M., & Gheibdoust, H. (2024). The role of humanitarian supply chain management in environmental crises. Unpublished manuscript.
- [10]. Kahn, L., Ortiz-Ulloa, B., Pavon-Harr, V., & Savas, O. (2019). Artificial intelligence (AI) augmentation for humanitarian logistics: A framework and visual tool for planning and communicating optimal evacuation routes for natural hazards. Unpublished manuscript.
- [11]. Zamani, E. D., Smyth, C., Gupta, S., & Dennehy, D. (2023). Artificial intelligence and big data analytics for supply chain resilience: A systematic literature review. *Annals of Operations Research*, 327(2), 605–632.
- [12]. Malhouni, Y., & Mabrouki, C. (2022). Humanitarian and traditional supply chains: An in-depth comparison for better cross-learning. In *Proceedings of LOGISTIQUA 2022* (pp. 247–259).
- [13]. Argollo da Costa, S. R., Bandeira, R., Mello, L., & Campos, V. (2014). Humanitarian supply chain: An analysis of response operations to natural disasters. *European Journal of Transport and Infrastructure Research*, 14, 290–310.
- [14]. Seifert, L., Kunz, N., & Gold, S. (2017). Humanitarian supply chain management responding to refugees: A literature review. *Journal of Humanitarian Logistics and Supply Chain Management*, 8(3), 398–426.
- [15]. Dennehy, D., Oredo, J., Spanaki, K., Despoudi, S., & Fitzgibbon, M. (2021). Supply chain resilience in mindful humanitarian aid organisations: The role of big data analytics. *International Journal of Operations & Production Management*, 41(9), 1417–1441.
- [16]. Gallego, V., Naveiro, R., Roca, C., Rios Insua, D., & Campillo, N. E. (2021). AI in drug development: A multidisciplinary perspective. *Molecular Diversity*, 25, 1461–1479.
- [17]. Sun, Z., Sandoval, L., Crystal-Ornelas, R., Mousavi, S. M., Wang, J., Lin, C., & John, A. (2022). A review of earth artificial intelligence. *Computers & Geosciences*, 159, 105034.
- [18]. Bari, L. F., Ahmed, I., Ahamed, R., Zihan, T. A., Sharmin, S., Pranto, A. H., & Islam, M. R. (2023). Potential use of artificial intelligence (AI) in disaster risk and emergency health management: A critical appraisal on environmental health. *Environmental Health Insights*, 17, 11786302231217808.

- [19]. Velev, D., & Zlateva, P. (2023). Challenges of artificial intelligence application for disaster risk management. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, 48, 387–394.
- [20]. Pizzi, M., Romanoff, M., & Engelhardt, T. (2020). AI for humanitarian action: Human rights and ethics. *International Review of the Red Cross*, 102, 145–180.
- [21]. Sivarajah, U., Kamal, M. M., Irani, Z., & Weerakkody, V. (2017). Critical analysis of big data challenges and analytical methods. *Journal of Business Research*, 70, 263–286.
- [22]. Kondraganti, A. (2021). Big data analytics in humanitarian and disaster operations: A systematic review. Unpublished manuscript.
- [23]. Yakobi, K., Scholtz, B., & Vom Berg, B. (2020). A conceptual model of the challenges of social media big data for citizen e-participation: A systematic review. In *Proceedings of the Conference on e-Business, e-Services and e-Society* (pp. 247–259). Springer.
- [24]. Dubey, R., Gunasekaran, A., Childe, S. J., Roubaud, D., Fosso Wamba, S., Giannakis, M., & Foropon, C. (2019). Big data analytics and organisational culture as complements to swift trust and collaborative performance in the humanitarian supply chain. *International Journal of Production Economics*, 210, 120–136.
- [25]. Dubey, R., Gunasekaran, A., Bryde, D. J., Dwivedi, Y. K., & Papadopoulos, T. (2020). Blockchain technology for enhancing swift-trust, collaboration and resilience within a humanitarian supply chain setting. *International Journal of Production Research*, 58(11), 3381–3398.
- [26]. Xu, W., Li, W., Proverbs, D., & Chen, W. (2023). An evaluation of the humanitarian supply chains in the event of flash flooding. *Water*, 15(18).
- [27]. Yadav, D. K., & Barve, A. (2015). Analysis of critical success factors of humanitarian supply chain: An application of interpretive structural modeling. *International Journal of Disaster Risk Reduction*, 12, 213–225.
- [28]. Behl, A., & Dutta, P. (2019). Humanitarian supply chain management: A thematic literature review and future directions of research. *Annals of Operations Research*, 283, 1001–1044.
- [29]. Dubey, R., Gunasekaran, A., Childe, S. J., Fosso Wamba, S., Roubaud, D., & Foropon, C. (2021). Empirical investigation of data analytics capability and organisational flexibility as complements to supply chain resilience. *International Journal of Production Research*, 59(1), 110–128.
- [30]. Li, X., & Lv, Y. (2021). Big data-driven disaster management: A key approach for smart humanitarian activity. In *IEEE 21st International Conference on Communication Technology* (pp. 1449–1454). IEEE.
- [31]. Beduschi, A. (2022). Harnessing the potential of artificial intelligence for humanitarian action: Opportunities and risks. *International Review of the Red Cross*, 104(919), 1149–1169.
- [32]. Madianou, M. (2020). Non-human humanitarianism: When AI for good turns out to be bad. *AoIR Selected Papers of Internet Research*.
- [33]. Ali, A., Mahfouz, A., & Arisha, A. (2017). Analysing supply chain resilience: Integrating the constructs in a concept mapping framework via a systematic literature review. *Supply Chain Management: An International Journal*, 22(1), 16–39.
- [34]. Tatham, P. H., Spens, K. M., & Taylor, D. (2009). Development of the academic contribution to humanitarian logistics and supply chain management. *Management Research News*, 32(11).
- [35]. Lewin, R., Besiou, M., Lamarche, J. B., Cahill, S., & Guerrero-Garcia, S. (2018). Delivering in a moving world... looking to our supply chains to meet the increasing scale, cost and complexity of humanitarian needs. *Journal of Humanitarian Logistics and Supply Chain Management*, 8(4), 518–532.
- [36]. Ivanov, D., & Dolgui, A. (2020). Viability of intertwined supply networks: Extending the supply chain resilience angles towards survivability. *International Journal of Production Research*, 58(10), 2904–2915.
- [37]. Agarwal, S., Kant, R., & Shankar, R. (2020). Evaluating solutions to overcome humanitarian supply chain management barriers: A hybrid fuzzy SWARA–Fuzzy WASPAS approach. *International Journal of Disaster Risk Reduction*, 51, 101838.
- [38]. Venkatesh, V. G., Zhang, A., Deakins, E., Luthra, S., & Mangla, S. (2019). A fuzzy AHP-TOPSIS approach to supply partner selection in continuous aid humanitarian supply chains. *Annals of Operations Research*, 283, 1517–1550.
- [39]. Fathalikhani, S., Hafezalkotob, A., & Soltani, R. (2020). Government intervention on cooperation, competition, and cooptation of humanitarian supply chains. *Socio-Economic Planning Sciences*, 69, 100715.

- [40]. Petrucci, S. H. H., Taviana, M., & Abdi, M. (2020). A comprehensive framework for analysing challenges in humanitarian supply chain management: A case study of the Iranian Red Crescent Society. *International Journal of Disaster Risk Reduction*, 42, 101340.
- [41]. Zhang, J., Wang, Z., & Ren, F. (2019). Optimisation of humanitarian relief supply chain reliability: A case study of the Ya'an earthquake. *Annals of Operations Research*, 283(1), 1551–1572.
- [42]. Nagurney, A., & Qiang, Q. (2019). Quantifying supply chain network synergy for humanitarian organisations. *IBM Journal of Research and Development*, 64(1/2), 12:1–12:14.
- [43]. Kunz, N., & Gold, S. (2017). Sustainable humanitarian supply chain management—exploring new theory. *International Journal of Logistics Research and Applications*, 20(2), 85–104.
- [44]. Azmat, M., & Kummer, S. (2020). Potential applications of unmanned ground and aerial vehicles to mitigate challenges of transport and logistics-related critical success factors in the humanitarian supply chain. *Asian Journal of Sustainability and Social Responsibility*, 5(1), 3.
- [45]. Prasad, S., Zakaria, R., & Altay, N. (2018). Big data in humanitarian supply chain networks: A resource dependence perspective. *Annals of Operations Research*, 270(1), 383–413.
- [46]. Chen, F., Liu, S., & Appolloni, A. (2020). Horizontal coordination of I-LNGOs in the humanitarian supply chain: An evolutionary game approach. *Sustainability*, 12(15), 5953.
- [47]. John, L., Gurumurthy, A., Soni, G., & Jain, V. (2019). Modelling the inter-relationship between factors affecting coordination in a humanitarian supply chain: A case of Chennai flood relief. *Annals of Operations Research*, 283, 1227–1258.
- [48]. Torabi, S. A., Shokr, I., Tofighi, S., & Heydari, J. (2018). Integrated relief pre-positioning and procurement planning in humanitarian supply chains. *Transportation Research Part E: Logistics and Transportation Review*, 113, 123–146.
- [49]. L'Hermitte, C., Tatham, P., Brooks, B., & Bowles, M. (2016). Supply chain agility in humanitarian protracted operations. *Journal of Humanitarian Logistics and Supply Chain Management*, 6, 173–201.
- [50]. John, L., & Ramesh, A. (2012). Humanitarian supply chain management in India: A SAP-LAP framework. *Journal of Advances in Management Research*, 9(2), 217–235.
- [51]. Nayak, R., & Choudhary, S. (2022). Operational excellence in humanitarian logistics and supply chain management through leagile framework: A case study from a non-mature economy. *Production Planning & Control*, 33(6–7), 606–621.
- [52]. Stewart, M., & Ivanov, D. (2022). Design redundancy in agile and resilient humanitarian supply chains. *Annals of Operations Research*, 319(1), 633–659.
- [53]. Schiffling, S., Hannibal, C., Tickle, M., & Fan, Y. (2022). The implications of complexity for humanitarian logistics: A complex adaptive systems perspective. *Annals of Operations Research*, 319(1), 1379–1410.
- [54]. Charles, A., Lauras, M., Van Wassenhove, L. N., & Dupont, L. (2016). Designing an efficient humanitarian supply network. *Journal of Operations Management*, 47, 58–70.
- [55]. Jahre, M. (2017). Humanitarian supply chain strategies—A review of how actors mitigate supply chain risks. *Journal of Humanitarian Logistics and Supply Chain Management*, 7(2), 82–101.
- [56]. Stauffer, J. M., & Kumar, S. (2021). Impact of incorporating returns into pre-disaster deployments for rapid-onset predictable disasters. *Production and Operations Management*, 30(2), 451–474.
- [57]. Patil, A., Shardeo, V., Dwivedi, A., Madaan, J., & Varma, N. (2021). Barriers to sustainability in humanitarian medical supply chains. *Sustainable Production and Consumption*, 27, 1794–1807.
- [58]. Papadopoulos, T., Gunasekaran, A., Dubey, R., Altay, N., Childe, S. J., & Fosso-Wamba, S. (2017). The role of big data in explaining disaster resilience in supply chains for sustainability. *Journal of Cleaner Production*, 142, 1108–1118.
- [59]. Rodríguez-Espíndola, O., Chowdhury, S., Beltagui, A., & Albores, P. (2020). The potential of emergent disruptive technologies for humanitarian supply chains: The integration of blockchain, artificial intelligence and 3D printing. *International Journal of Production Research*, 58(15), 4610–4630.
- [60]. de Camargo Fiorini, P., Chiappetta Jabbour, C. J., Lopes de Sousa Jabbour, A. B., & Ramsden, G. (2022). The human side of humanitarian supply chains: A research agenda and systematisation framework. *Annals of Operations Research*, 319(1), 911–936.
- [61]. Ismail, I. (2021). A possibilistic mathematical programming model to control the flow of relief commodities in humanitarian supply chains. *Computers & Industrial Engineering*, 157, 107305.

- [62]. Aggarwal, C. C., & Yu, P. S. (2001). Outlier detection for high dimensional data. In *Proceedings of the 2001 ACM SIGMOD International Conference on Management of Data* (pp. 37–46).
- [63]. Harish, R., Harish, R. D., Kalaiselvi, D. K. R., & Hari, H. V. (2023). Arduino child caring robot. *International Journal for Research in Applied Science and Engineering Technology*, 11(6), 3915–3917.
- [64]. Manyika, J. (2022). Getting AI right: Introductory notes on AI & society. *Daedalus*, 151(2), 5–27.
- [65]. Jha, A. (2024). AI-driven algorithms for optimizing social media advertising. In *Advances in e-business research series* (Chapter 4).
- [66]. Kreutzer, T., Vinck, P., Pham, P. N., An, A., Appel, L., DeLuca, E., & Orbinski, J. (2019). Improving humanitarian needs assessments through natural language processing. *IBM Journal of Research and Development*, 64(1/2), 9:1–9:14.
- [67]. Kumar, P., Choubey, D., Amosu, O. R., & Ogunsuji, Y. M. (2024). AI-enhanced inventory and demand forecasting: Using AI to optimise inventory management and predict customer demand. *World Journal of Advanced Research and Reviews*, 23(1), 1931–1944.
- [68]. Zabinsky, Z. B., Zameer, M., Petroianu, L. P., Muteia, M. M., & Coelho, A. L. (2021). Route optimization tool (RoOT) for distribution of vaccines and health products. *Gates Open Research*, 5.
- [69]. Yousefzadeh, R. (2020). A probabilistic framework for optimising real-time decisions in humanitarian aid delivery systems. *arXiv preprint*.
- [70]. Alturki, I., & Lee, S. (2024). The humanitarian vehicle routing problem with non-routineness of trips. *Socio-Economic Planning Sciences*, 92, 101838.
- [71]. Masoumi, M., Aghsami, A., Alipour-Vaezi, M., Jolai, F., & Esmailifar, B. (2022). An M/M/C/K queueing system in an inventory routing problem considering congestion and response time for post-disaster humanitarian relief: A case study. *Journal of Humanitarian Logistics and Supply Chain Management*, 12(2), 182–219.
- [72]. Preil, D., & Krapp, M. (2022). Artificial intelligence-based inventory management: A Monte Carlo tree search approach. *Annals of Operations Research*, 308(1), 415–439.
- [73]. Fan, C., Zhang, C., Yahja, A., & Mostafavi, A. (2021). Disaster city digital twin: A vision for integrating artificial and human intelligence for disaster management. *International Journal of Information Management*, 56, 102049.
- [74]. Devitt, S. K., Scholz, J., Schless, T., & Lewis, L. (2023). Developing a trusted human-AI network for humanitarian benefit. *Digital War*, 4(1), 1–17.
- [75]. Nozari, H., Szmelter-Jarosz, A., & Ghahremani-Nahr, J. (2022). Analysis of the challenges of artificial intelligence of things (AIoT) for the smart supply chain (case study: FMCG industries). *Sensors*, 22(8), 2931.
- [76]. Ejjami, R., & Boussalham, K. (2024). Resilient supply chains in Industry 5.0: Leveraging AI for predictive maintenance and risk mitigation. *IJFMR International Journal of Multidisciplinary Research*, 6(4).
- [77]. Fauziah, L., Suharyanto, S., Herlina, R. L., Sutisna, A., & Gymnastiar, I. A. (2024). Smart operations: Implementing AI-driven technologies for enhanced efficiency in supply chain management. *Branding: Jurnal Manajemen dan Bisnis*, 3(1).
- [78]. Smyth, C., Dennehy, D., & Fosso-Wamba, S. (2021). A review of AI in the supply chain industry: Preliminary findings. In *Proceedings of I3E 2021* (pp. 454–466). Springer.
- [79]. Gupta, S., Altay, N., & Luo, Z. (2019). Big data in humanitarian supply chain management: A review and further research directions. *Annals of Operations Research*, 283(1), 1153–1173.
- [80]. Sahebi, I. G., & Jafarnejad, A. (2018). Demand forecasting of emergency resource in humanitarian supply chain. In *Proceedings of the 103rd IRES International Conference* (pp. 129–136).
- [81]. Chan, E. Y. (2006). Evidence-based public health practices: Challenges for health needs assessments in disasters. *Hong Kong Medical Journal*, 12(4), 324.
- [82]. Korteweg, H. A., van Bokhoven, I., Yzermans, C. J., & Grievink, L. (2010). Rapid health and needs assessments after disasters: A systematic review. *BMC Public Health*, 10, 1–12.
- [83]. Ragini, J. R., Anand, P. R., & Bhaskar, V. (2018). Big data analytics for disaster response and recovery through sentiment analysis. *International Journal of Information Management*, 42, 13–24.
- [84]. Swaminathan, J. M. (2018). Big data analytics for rapid, impactful, sustained, and efficient (RISE) humanitarian operations. *Production and Operations Management*, 27(9), 1696–1700.
- [85]. Makker, M., Ramanathan, R., & Dinesh, S. B. (2019). Post disaster management using satellite imagery and social media data. In *Proceedings of CSITSS 2019* (pp. 1–6).

- [86]. Maheshwari, S., Gautam, P., & Jaggi, C. K. (2021). Role of big data analytics in supply chain management: Current trends and future perspectives. *International Journal of Production Research*, 59(6), 1875–1900.
- [87]. Mathrani, S., & Lai, X. (2021). Big data analytic framework for organisational leverage. *Applied Sciences*, 11(5), 2340.
- [88]. Aljabhan, B., & Abeyie, M. (2022). Big data analytics in supply chain management: A qualitative study. *Computational Intelligence and Neuroscience*, 2022, 9573669.
- [89]. Warnier, M., Alkema, V., Comes, T., & Van de Walle, B. (2020). Humanitarian access, interrupted: Dynamic near real-time network analytics and mapping for reaching communities in disaster-affected countries. *OR Spectrum*, 42, 815–834.
- [90]. Jain, P., Tambuskar, D. P., & Narwane, V. S. (2023). Is the implementation of big data analytics in sustainable supply chain really a challenge? The context of the Indian manufacturing sector. *International Journal of Innovation and Technology Management*, 20(05), 2350033.
- [91]. Spence, P. R., & Lachlan, K. A. (2010). Disasters, crises, and unique populations: Suggestions for survey research. *New Directions for Evaluation*, 2010(126), 95–106.
- [92]. Morton, M., & Levy, J. L. (2011). Challenges in disaster data collection during recent disasters. *Prehospital and Disaster Medicine*, 26(3), 196–201.
- [93]. Chan, F. T., Samvedi, A., & Chung, S. H. (2015). Fuzzy time series forecasting for supply chain disruptions. *Industrial Management & Data Systems*, 115(3), 419–435.
- [94]. Fuqua, D., & Hespeler, S. (2022). Commodity demand forecasting using modulated rank reduction for humanitarian logistics planning. *Expert Systems with Applications*, 206, 117753.
- [95]. Kumar, A., Latif, Y. L., & Daver, F. (2012). Developing forecasting tool for humanitarian relief organisations in emergency logistics planning. *World Academy of Science, Engineering and Technology Journal*, 1687–1693.
- [96]. Hasan, M. H., Ahmed, A., Nafee, K. M., & Hossen, M. A. (2023). Use of machine learning algorithms to assess flood susceptibility in the coastal area of Bangladesh. *Ocean & Coastal Management*, 236, 106503.
- [97]. Abhulimen, A. O., & Ejike, O. G. (2024). Solving supply chain management issues with AI and big data analytics for future operational efficiency. *Computer Science & IT Research Journal*, 5(8), 1780–1805.
- [98]. Ortuño, M. T., Ferrer, J. M., Flores, I., & Tirado, G. (2021). Optimisation of humanitarian logistics. In *International Encyclopedia of Transportation*.
- [99]. de Vries, H. (2017). Evidence-based optimisation in humanitarian logistics. Erasmus University Rotterdam.
- [100]. Klundert, J. V., Wagelmans, A. P., & de Vries, H. (2013). Evidence-based optimisation in humanitarian logistics. Unpublished manuscript.
- [101]. Wang, Y., Li, J., Zhao, X., Feng, G., & Luo, X. (2020). Using mobile phone data for emergency management: A systematic literature review. *Information Systems Frontiers*, 22, 1539–1559.
- [102]. Serrato-Garcia, M. A., Mora-Vargas, J., & Murillo, R. T. (2016). Multi objective optimisation for humanitarian logistics operations through the use of mobile technologies. *Journal of Humanitarian Logistics and Supply Chain Management*, 6(3), 399–418.
- [103]. Villegas-Ch, W., García-Ortiz, J., & Sánchez-Viteri, S. (2024). Towards intelligent monitoring in IoT: AI applications for real-time analysis and prediction. *IEEE Access*.
- [104]. Prabhakaran, P., Velammal, R. S., Manopriya, V., Prema, A. E., Chitradevi, R., & Kumar, D. P. (2024). Revolutionizing stock trading: The impact of AI on decision-making and efficiency. *International Journal for Research in Applied Science and Engineering Technology*, 12(8), 849–852.
- [105]. Laguna Salvadó, L., Laurus, M., & Comes, T. (2016). Towards a monitoring system for American IFRC logistics network. In *ISCRAM Proceedings*.
- [106]. Yang, H., Yang, L., & Yang, S. H. (2011). Hybrid Zigbee RFID sensor network for humanitarian logistics centre management. *Journal of Network and Computer Applications*, 34(3), 938–948.
- [107]. Yagci Sokat, K., Zhou, R., Dolinskaya, I. S., Smilowitz, K., & Chan, J. (2016). Capturing real-time data in disaster response logistics. *Journal of Operations and Supply Chain Management*, 9(1), 23–54.
- [108]. Budak, A., Kaya, I., Karaşan, A., & Erdoğan, M. (2020). Real-time location systems selection by using a fuzzy MCDM approach: An application in humanitarian relief logistics. *Applied Soft Computing*, 92, 106322.
- [109]. Zouari, D., Ruel, S., & Viale, L. (2021). Does digitalising the supply chain contribute to its resilience? *International Journal of Physical Distribution & Logistics Management*, 51(2), 149–180.

-
- [110]. Belhadi, A., Mani, V., Kamble, S. S., Khan, S. A. R., & Verma, S. (2024). Artificial intelligence-driven innovation for enhancing supply chain resilience and performance under the effect of supply chain dynamism: An empirical investigation. *Annals of Operations Research*, 333(2), 627–652.
- [111]. Modgil, S., Singh, R. K., & Hannibal, C. (2022). Artificial intelligence for supply chain resilience: Learning from Covid-19. *The International Journal of Logistics Management*, 33(4), 1246–1268.
- [112]. Singh, D., Sharma, A., Singh, R. K., & Rana, P. S. (2024). Augmenting supply chain resilience through AI and big data. *Business Process Management Journal*, 31(2), 631–657.
- [113]. Bag, S., Dhamija, P., Luthra, S., & Huisingh, D. (2023). How big data analytics can help manufacturing companies strengthen supply chain resilience in the context of the COVID-19 pandemic. *The International Journal of Logistics Management*, 34(4), 1141–1164.