The Role of Big Data in Humanitarian Organisations in Developing Countries: A Systematic Literature Review

by

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Abstract

Being financially and technologically worse off than their counterparts in developed nations, many developing countries face natural disasters that cut them off from the rest of the world and cause excessive damage to invaluable human life and property. Sudden disasters require timely and accurate response from stakeholders to provide immediate relief while deploying scarce resources effectively. However, due to the large number of humanitarian aid agencies from different developed countries and a lack of knowledge, there is duplication of relief in many areas while countless more are left unattended. In this thesis, Resource Dependence Theory and Stakeholder Theory were employed to analyse how humanitarian organisations deliver services during a disaster. Systematic literature review was utilised for collecting data and the data was analysed using thematic analysis.

During the data collection process, 300 papers were initially identified however, after further reassessment, 33 papers were left to be further analyzed. From this the researcher was able to identify that the use of Big Data in developing countries is proving to be extremely beneficial to humanitarian efforts, according to this thesis. It also explains how humanitarian organizations can make better use of big data by overcoming obstacles. The thesis suggests that increasing the number of data scientists and specialists by conducting big data training for staff, improving data governance (regulations, controls, and transparency), and enhancing privacy and security will result in major improvements in humanitarian operations. Given the importance of private stakeholders, companies' roles extend far beyond delivering profits to their shareholders, they must also address social issues by participating in disaster and humanitarian operations in developing countries.

Table of Contents

1.0 Chapter One: Introduction

In the modern world, technology plays a pivotal role in shaping the way people and businesses achieve success. Therefore, as Weiss (2016) has observed, to develop technology and understand its impact, it is necessary to assess how technology is applied. This research focuses on the role that big data plays in implementing services in humanitarian operations. Specifically, this study seeks to understand how developing countries have utilized big data in responding to emergencies. As Weiss (2018) has noted, over the years, billions have been spent trying to better people's lives. This is usually done to provide relief, particularly during a catastrophe. This helps lighten the burden of those influenced by catastrophe (Day et al., 2012).

The term "big data" can refer to the systematic extraction of information that is large or complex (Solis, 2016). The application of big data can be useful to improve people's lives by understanding the information people need during a crisis. According to Jett (2019), it can be used to extract information that helps analyze the conditions of those affected by the situation. Big data is an important factor that influences data processing and organizations' ability to engage in technological growth based on specific information gathering and processing (Solis 2016).

Humanitarian operations refer to the way assistance is provided to people and society in terms of financial competence and the expansion of efforts to curb the excessive use of limited resources (Clarke, 2018). According to Clarke (2018), it also helps provide stability in terms of assistance during catastrophes. Thus, humanitarian operations can seek the assistance of the government and various humanitarian services to improve conditions in the disaster area. In this regard, as Crawford and Pert (2020) have stated, the application of big data is feasible in humanitarian services that help individuals before they receive further aid from the government.

Although multiple definitions of developing countries exist, in this thesis, a developing country, also known as an emerging or transitional economy, is one with an underdeveloped industrial base and a low human development index (HDI) in comparison to other countries. Developing countries have tended to show stronger growth rates than developed countries, as well as other societal developments, since the late 1990s (Sinha et al., 2018). They are countries in which the average yearly income is low, most of the population is engaged in agriculture, and the majority of the residents live below the poverty line (Das et al., 2016). In general, these countries are on the way to becoming industrialized but have limited resources to address their economic issues (Shareef 2008). Therefore, emerging countries are underdeveloped; heavily reliant on foreign capital, development aid, agriculture, and natural resources; and lack a solid industrial base (Sinha et al., 2018).

In these cases, the role big data play is crucial mainly because it can help with gathering the information needed to implement humanitarian aid. According to Minear (2019), humanitarian organizations can apply big data to deliver humanitarian assistance before government involvement. Wolfert et al. (2017) have stated that the humanitarian supplies could be enhanced to promote human welfare and ensure that help is provided only where it is needed. This can also be beneficial for governments, as excess or unnecessary help can be rejected based on the information generated via big data.

However, Günther et al. (2017) have stated big data can only be applied for humanitarian operations in developed countries because the data, devices, and technology needed to achieve accurate results are usually expensive and can be difficult for developing countries to attain. At the same time, Oussous et al. (2018) have stated that humanitarian activities are more common in developing countries than in developed ones. Hence, this work considers the role big data plays in

the humanitarian operations of developing countries as an opportunity to understand its impact. Furthermore, inputs from benefactors and government are a major factor mainly because financial and technological competence are improved with the assistance provided in humanitarian operations. Developing countries must address issues related to financial incompetence and non-cooperation from the government.

In the words of Zhou et al. (2016), addressing catastrophes is difficult without the proper use of technology. The excessive damage caused is one challenge that governments of such countries need to consider. It is necessary that support from stakeholders and relief providers be involved in helping during a disaster. Thus, the application of big data is an important tool to implement a humanitarian approach in developing nations.

1.1 Problem Statement

Based on the understanding of the situation, the problem this research investigates is that the digital revolution has not been considered effective in most developing countries. It is essential that these countries be developed technologically so that assistance during a humanitarian crisis can be provided. In this regard, the application of big data can be useful for development and for assisting with humanitarian operations. Big data also helps clarify the limitations that developing countries may face while in incorporating big data and the related technology. Hence, this problem is worthy of being researched.

Developed countries like Canada use large-scale analysis to apply big data in humanitarian operations (Dubey et al., 2019). This is a major reason for these countries' success and is a reason to implement this technology. Disasters have led to tremendous losses for people all around the world. Therefore, any form of recovery that can help people can be presumed an advancement in

the world. The most significant problem that developing countries face is that, with a low level of technology, warnings or information about a possible catastrophe may arrive too late. Unlike a developed country like Canada or the United States, developing countries are affected more by natural disasters due to a lack of understanding of a catastrophe's magnitude (Dubey et al., 2019).

We live in an age of digital revolution. Thanks to the assistance of technology, digital applications, and the effective use of media, information related to various aspects of life and business are easily transferred from one place to another. Hence, information regarding disasters or the requirements of humanitarian operations can be transmitted. Therefore, technological advancement is the ultimate way that assistance related to humanitarian services can be provided to relieve people effectively during a crisis. Nevertheless, people in developing nations do not experience this benefit. Therefore, this research aims to identify the role big data plays in aiding humanitarian operations in these countries.

However, many people are wary of big data. Solis (2016) has noted that many consider the technical advancement and usage of big data problematic. As a result, developing countries have not been able to grow steadily in terms of applying big data, mainly because developing countries have not been successful on the implementation of this technology. Additionally, many have shunned big data programs due to the financial requirements for their success (Solis 2016). This is another way big data may seem unfeasible for developing countries. Overall, the problem lies with the use of big data for assisting with humanitarian operations. In the words of Wolfert et al. (2017), developing countries are technically and financially challenged; hence, they tend to suffer during catastrophic situations.

The thesis analyzes the role big data plays in supporting humanitarian programs by gathering information and analyzing it to help with development. Therefore, this research seeks to eliminate doubts related to the use of big data for humanitarian operations in developing countries. The aim, objective, and research questions suitable for conducting the research are now addressed.

1.2 Rationale for the Topic

Some researchers call the current era a data tsunami, while others describe it as a digital revolution. Regardless, as humans in this digital age extensively use digital technologies to transfer data rapidly, it is surprising that humanitarian operations do not appropriately use these technological advancements to their fullest potential. The term "big data" alarms many, who think that it is an elaborate number-crunching phenomenon beyond their grasp. Humanitarians, especially those working in the field and actively engaged in recovery programs, are both challenged and handicapped by their fear of technology, which is a major hindrance in adopting it. This topic was chosen because the researcher wanted to understand the reluctance to use big data and identify its potential to assist with humanitarian operations.

The interest in humanitarian services stems from my experience as a project planner with the British Red Cross in Aberdeen, Scotland, United Kingdom during my undergraduate degree. The British Red Cross is a volunteer-led humanitarian organization that assists individuals in need, regardless of their location. They help individuals who are vulnerable at home and abroad to plan for and respond to disasters in their communities. In addition, once the crisis has passed, the British Red Cross assists people with recovering and moving on with their lives.

I assisted with and delivered fundraising and awareness plans as an intern and performed administrative tasks (e.g., typing correspondence, sending fundraising packs and certificates, and

maintaining efficient filing systems). I also responded to internal and external phone calls, as well as supporter calls, as needed and maintained the International Red Cross and Red Crescent Movement's Fundamental Principles while working within the Society's Equal Opportunity Policy. In addition, I attended events and aided with coordination, volunteer management, and other tasks on the day of events. This opportunity allowed me to perceive the benefits of sharing information in a developed context, which piqued my interest in learning how this could be applied to the developing sector to reduce people's suffering after a disaster.

1.3 Research Aim and Research Questions

The aim of the research is to understand the way developing countries can implement big data and apply it in humanitarian operations. The main research question for the study is the following: How is big data used for humanitarian operations in developing countries? Secondary questions related to the research objectives are also analyzed. The research questions related to the research objectives are as follows:

- What are the objectives of using big data for humanitarian operations management?
- What is the range of humanitarian activities that developing countries support through big data analytics (BDA)?
- What challenges exist in deploying big data for humanitarian operations management?

1.4 Research Objective

In response to the research aim, the following objectives are proposed for this study:

- To understand the objectives of using big data for humanitarian operations management

- To explore the range of humanitarian activities that developing countries support through BDA

- To investigate the challenges faced in deploying big data for humanitarian operations management

1.5 Thesis Outline

The thesis consists of six chapters, and each concerns a distinct aspect of the topic. Each chapter has subdivisions that highlight its contribution and relevance to the research. The six chapters consist of the introduction, background, research methodology, literature review, data analysis, and conclusion.

Chapter one (introduction): This chapter presents the current understanding of the topic and sets the tone of the thesis. It outlines the problem statement associated with the study, which clarifies the issues related to the research and identifies the research aim. Based on the research aim, objectives and questions are formulated to guide the study.

Chapter two (background): This chapter contains a discussion of the concept of big data and humanitarian operations. It further outlines historical developments in the literature that led to the current topic. The background section, therefore, provides general information about the research topic and emphasizes the main aims of the study.

Chapter three (literature review): The literature review addresses the concepts associated with the research and includes an analysis of research on the topic. The main areas relating to the aims and objectives of the research are outlined, and the key arguments on big data and humanitarian operations are presented in a table. Secondary sources, such as academic journals and non-governmental organizations' (NGO) publications, are included. The literature

review also discusses relevant theories this thesis employs (i.e., resource dependence theory and stakeholder theory). The literature review is useful for the data analysis and for linking the research objectives with the data.

Chapter four (research methodology): The research methodology is an important chapter because it shapes this study by determining the most appropriate types of analysis. The methodology chapter identifies the secondary data sources utilized and discusses the research approach. In this section, an in-depth explanation of the overall research method for the study and each technique utilized is analyzed in detail.

Chapter five (data analysis and discussion): The data analysis helps identify the results after the data was gathered. The data analysis integrates the results and analyzes them with the previous evidence. The results are addressed thematically; they include conclusions and suggestions and are discussed based on the analysis and the evidence from the literature review.

Chapter six (conclusion and recommendations): The final chapter concludes the study. It summarizes the data collection process, including the aim and objectives of the research. The chapter determines how each study objective is met via the data analysis and the literature review. The chapter also provides recommendations so that adjustments can be made for future research and for companies who use or who intend to adopt big data in their operations. Future implications of the topic are also addressed.

2.0 Chapter Two: Background

In this section, the historical developments in the literature that led to selecting the topic of this study are outlined. The advent of technological advancement in big data is reviewed, and the problems BDA faces are outlined. Finally, the background of the concept of big data and humanitarian operations are discussed.

2.1 Digital Revolution

French and Shim (2016) have argued that the digital revolution or the third industrial revolution shifted from mechanical and related electronic technology to digital electronic technology. This was done by accepting and propagating the benefits digital technology promised for businesses. Technological advancement created an ocean of opportunities for businesses to function smoothly. As Kendzia and Björck (2018) have noted, the digital revolution greatly influences business, industries, and individuals. Every type of industry and organization has observed the digital revolution, which has helped them create innovation and improve performance.

Technology has helped attract more consumers and made businesses more agile and flexible. As Cascio and Montealegre (2016) have argued, seven major technologies have transformed the establishment of international organizations and the business that drives them: big data, the cloud, machine learning, mobile computing, advanced robotics and drones, sensors and intelligent manufacturing, and clean energy production. These advanced technologies help people work more effectively and faster and facilitate thoughtful transformations (CEPAL, 2016). Globally, organizations try to adapt to the digital revolution to increase their financial growth and social development.

2.2 The Advent of Technological Advancement in Big Data

Technological advancement in the global economy has played a central role in the growth and development of business operations that have embraced the digital era (Çalışkan, 2015). According to researchers' observations, technological advancements have paved the way for innovative devices that have advanced economies. Technology has brought change and advancement for thriving companies and their procedures. Technological innovation has provided a higher standard of living, information storage, and catering to day-to-day tasks in a hassle-free manner. Most business organizations have embraced the idea of big data in their business operations. According to Singh (2019), one major advancement has occurred in the field of big data operations. The emergence of big data indicates that companies have opted for continuous development. Big data technologies are the central focus within science and industry, and they relate to all aspects of human activity, including production and research design.

The current technologies used in big data, such as cloud computing and ubiquitous networks, provide scope for connectivity and automation in aspects of every form of data collection (Basha et al., 2019). Cloud computing is a system or concept that provides rapid, convenient, on-demand network access to a shared pool of configurable equipment such as servers, networks, storage devices, applications, services, and other advanced computing devices (Paul & Ghose, 2012). The spread of communications infrastructure and wireless technologies throughout the environment to enable continuous connectivity is known as ubiquitous networking (Hwang, 2014). Technological advancement has supported and shaped global businesses in numerous ways and is considered the modern form of business globalization. Globally, various companies depend on the usage of technology, adhering to their fruitful performance in several organizations. The

process of technological development has improved living standards by increasing productivity, lowering production costs and charges, and helping lift real wages (*Unctad.org*, 2020). Technological advancements have enabled most software experts to work collectively to create growth and profit within companies (Çalışkan, 2015). However, as Samaddar (2016) has argued, technological advancement also makes industries and individuals dependent on gadgets, which leads people to rely on technology and doubt their abilities. Nevertheless, with innovation, businesses have achieved better global engagement networks.

Big data comprises diverse types of essential technologies, such as prescriptive analytics, diagnostic analytics, descriptive analytics, and predictive analytics. They all help attain the desired goals, such as the extraction of value from the given data, which was considered as irrelevant (Dietrich et al., 2015). These analytics have diverse operations and many uses. According to a study by Zakir et al. (2015), big data is a significant concept; it describes data that does not conform to the normal structure of the traditional database. Big data analytics is a way to obtain value from enormous quantities of information. It drives novel market opportunities and aids consumer retention.

Big data is obtained from numerous sources. As Zakir et al. (2015) have argued, it comprises not only structured data, but also all prototypes of unstructured data resources, which are increasing at a momentous rate. Structured data is defined as data that can be stored, retrieved, and processed in a specific format; it is data that has been organized at a high level, such as information in a relational database. When data is well-structured and predictable, search engines can more easily organize and present it in creative ways. Unstructured data refers to any data that has an unfamiliar form or organization. Such data provides various obstacles in processing to extract value from it, ranging from those mentioned above to its vast size. The term "unstructured data"

is used to describe data that is not stored in a database or other data structure. As Riahi and Riahi (2018) have noted, there are four categories of BDA: descriptive analytics (what happened), diagnostic analytics (acknowledging why it happened), predictive analytics (looking forward to what might happen next), and prescriptive analytics (ascertaining how to affect upcoming occurrences). Each has distinct features and functions which has a significant impact on businesses. However, the execution and use of analytics are increasingly complicated. In addition, big data needs tools and techniques to accumulate, manage, and comprehend the organizational data to benefit the company (Baker, 2016).

Moreover, big data is highly important in business activities in today's world. Data analytics has sometimes proven to be significant for companies. According to the study of Alsghaier et al. (2017), many opportunities are connected to data analysis in numerous businesses. Big data analytics also help manage or determine significant universal issues, such as the creation of new technical breakthroughs, advanced human health solutions, and enhanced decision-making by offering actual-time streams of knowledge *(Unctad.org*, 2020).

According to Lukić (2017), big data technologies proffer new opportunities for augmentation and growth and to form novel companies and organizations whose business model is based on data. Big data plays a principal role in corporations' performance by retaining existing consumers and recognizing new ones in the market. It has been observed that organizations that use big data technologies comprehend their consumers, workforce, business processes, and collaborators and recognize areas that require upgrades.

Moreover, transparency is key to running business activities smoothly and quickly. Data, which exists both externally and internally in the organization, is accessible in one place. This helps organizations create one version of the truth. The workforce can easily access the required

data in that location, which saves time and promotes efficiency. Additionally, it is necessary to identify diverse types of consumers and create more custom services and products to suit their needs. Organizations can eventually gather more thorough data about their consumers and their views and outlook about products and services the company offers. Furthermore, it assists with the recognition of dissimilar consumer segments to regulate products and services to meet consumer needs. By targeting these segments, organizations gain a comprehensive portrait of how the company can better fulfill consumer requirements and, therefore, develop products and services as well as produce new ones. Big data also supports decision-making procedures with computerized algorithms. Big data has made it possible to analyze the assembled data and take corrective actions without human intervention. This results in an improved decision-making procedure (Lukić, 2017).

2.3 Problems in Big Data Analytics

Even though it is one of the most versatile and universally accepted elements of the digital revolution, big data also has disadvantages. The first is the associated risk of privacy and security. This is one of the most serious disadvantages, and it can make companies an easier target for cyber attackers. Additionally, even highly advanced companies have experienced major data breaches. However, because of the General Data Protection Regulation (GDPR), companies have sought to increase their investment in protocols, processes, and infrastructure to sustain big data (Kubina et al., 2015). Another issue is the requirement for technical expertise. Working with big data requires a great deal of proficiency in technology. Therefore, data experts and scientists are highly paid and sought-after in the IT landscape (Almeida, 2017).

Hiring the right talent or training the existing workforce also increases the overall business cost, which can be expensive. Additionally, it has been observed that big data infringes on privacy, as data breaches are possible (Ajah & Nweke, 2019). Big data is mainly used to accumulate data about customers to offer better services by identifying their buying trends. However, the manipulation of consumer data is possible without big data. This data is not useful on a short-term basis, as it takes time to analyze the data and leverage its benefits (Nedelcu, 2013).

Sometimes, the results from BDA can be misleading due to technical issues or incorrect interpretations. Furthermore, businesses that use big data need to re-evaluate their business plans, as big data can influence them. Big data convergence requires an approach that differs significantly from traditional methods, and a strategic alteration may be required. Nevertheless, regardless of these disadvantages, big data is one of the most powerful features of the digital revolution, and in the future, it will be sufficiently advanced to surpass the challenges and become easier to use.

As Nasser and Tariq (2015) have noted, there are issues with big data that can be classified into three major groups: data, process, and management challenges. With the accumulation of data, organizations face many issues. The challenges related to big data include data integration complexity; choosing the right project; designing the big data system; a lack of skills or appropriate staff; data ownership and other political issues; a lack of business sponsorship; data security, governance, and privacy; dealing with data in real time; poor data quality; inadequate infrastructure; the high cost; and cultural issues. As Espinosa et al. (2019) have argued, the actual challenge of using big data is ultimately big data: it consists of large volumes of intricate, vital data in enormous databases. Additionally, industries and organizations have identified the problematic volume, variety, and velocity of the data.

2.4 Concept and Significance of Humanitarian Data

According to a study by Thow et al. (2013), humanitarian data can be defined as data about the occurrence of a disaster based on information from the event, as well as damage assessments and related matters. Big data is accessible during crises. Individuals who use digital technology to aid during a crisis use digital humanitarianism through, for example, BDA, crowdsourcing, and mapping. For example, with the power of digital technology, during the Haiti earthquake, humanitarian aid was provided to many. The big data operators gradually gathered social media messages through volumes of data related to the crisis, including short message service (SMS) from victims. Data during humanitarian crises are sifted using online crowd sourcing or crowd maps through the collection, visualization, and mapping of citizens. Additionally, the data also concerns those affected by the crisis and who are in need. It is also useful to organizations and individuals looking to help those who require support *(Humanitarian Data Exchange*, 2020). The main goal of humanitarian data is to help people who are in need. The World Humanitarian Data and Trends provides universal and country-level data-and-trend investigations about humanitarian crises and assistance (*Unocha.org*, 2020).

The main function of humanitarian data is to combine this information and make it available to policymakers, analysts, and humanitarian professionals. The data can act as a substantive base to underpin humanitarian policy decisions and offer a framework for functional decisions. World Humanitarian Data and Trends is a proposal of the Policy Analysis and Innovation Section of the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) Policy Development and Studies Branch (PDSB). The publicly shared data should be accumulated or anonymized to prevent the recognition of individuals or to prevent other forms of harm to affected people and the

humanitarian community. Non-personally identifiable information (PII) includes company phone numbers and race, religion, gender, workplace, and job titles (*Unocha.org*, 2020).

The Humanitarian Data Exchange (HDX) does not permit data shared confidentially inside a company's partisanship to contain private information, such as contact information for humanitarian responders *(Humanitarian Data Exchange*, 2020). The HDX tries to avoid openly shared data, such as identifiable community information (CII) or demographically identifiable information (DII), that may endanger affected individuals. On the other hand, without in-depth evaluation, it is difficult to determine that data is not identifiable. Therefore, users of the HDX should notify the HDX team to create awareness of data on their site *(Humanitarian Data Exchange*, 2020).

2.5 Summary

This chapter has discussed the concept of big data and humanitarian data and operations. The meaning of big data, types, categories, functions, and its drawbacks were also specified, and the digital revolution and its transformation to digital technology were outlined. The adoption of advanced technology in various businesses and industries has led to better performance in their operations. By incorporating big data into their operations, most businesses have opted for continuous development. Big data analytics also aid in managing or determining significant universal issues, such as the creation of new technical breakthroughs, advanced human health solutions, and enhanced decision-making by offering actual-time streams of knowledge.

<h1 style="text-align:center">3.0 Chapter Three: Literature Review</h1>

To achieve the aim of the research, it is important to review the literature. According to Boote and Beile (2005), to conduct a significant study, a researcher must first understand the literature in the area that is being investigated. This research is supported with data gathered from secondary sources. The literature review in this thesis aims to provide a comprehensive understanding of the topic: big data and its role in humanitarian operations in developing countries. The data obtained from the papers identified in the systematic literature review highlights the advantages, roles, and operations that are significant regarding big data in humanitarian organizations. The literature review provides a comprehensive understanding of the impact of utilizing big data and its role in different fields. This section details the systematic literature review process. A table summarizes the articles included and excluded in the systematic literature review, a literature summary, the theoretical frameworks adopted for the thesis—resource dependence theory (RDT) and stakeholder theory (ST)—and a chapter summary.

3.1 The Systematic Literature Review Process

The systematic literature review process was conducted using the steps indicated by Okoli (2015). The researcher undertook the review in distinct stages. First, the purpose of the review was identified, and second, a review protocol was developed. Third, the researcher identified the inclusion and exclusion criteria for relevant publications. An in-depth search for studies was then performed, followed by critical appraisal, data extraction, and a synthesis of past findings. The next sub-sections describe these stages in detail as well as the methods used.

3.1.1 Step 1: Identifying the purpose. The literature review in this work is categorised as a free-standing paper that specifically reviews research on a subject. In this case, determining a

literature review's purpose should answer the question: Why do a literature review? The key purpose of conducting this review was to answer a specific research question regarding the role of big data in humanitarian operations, to analyze the progress of a specific research stream, and to make recommendations for future research. The review process was driven by research questions the author identified to provide pragmatic solutions by capturing concrete, meaningful aspects supported by empirical evidence.

3.1.2 Step 2: Drafting protocol and training the team. The research team which constitutes the researcher of this study, the thesis supervisor and two thesis committee members discussed in detail the draft protocol for the systematic review; the researcher's role was explained by the committee members, as the review process was solely carried out by the researcher. This step involved the development of a protocol to determine the search criteria for research papers. In accordance with the guidelines, procedures, and policies of Higgins and Green (2008), the protocol established the main research question that guided the selection of papers, the search strategy, inclusion and quality criteria, and the method of synthesis. The review process was driven by the following question: How is big data used for humanitarian operations in developing countries? Secondary questions related to the research objectives were also developed. The following research questions are related to the research objectives: What are the objectives of using big data for humanitarian operations management? What is the range of humanitarian activities that developing countries support through BDA? What are the challenges of deploying big data for humanitarian operations management? By focusing on these elements of the research question, the subject areas and relevant publications and materials were identified.

3.1.3 Step 3: Applying a practical screen. The inclusion and exclusion criteria helped practically screen the literature related to the role of big data in humanitarian operations. Due to

the importance of the selection phase in determining the overall validity of the literature review, several inclusion and exclusion criteria were applied. Studies were eligible for inclusion if they focused on the topic of how big data interacts with humanitarian operations. Publications were selected from 2010 onwards, since that is when the term gained momentum in academic and business communities. The systematic review included research papers published in academic outlets, such as journal articles and NGO publications. In-progress research and dissertations were excluded from this review, as were studies that were not written in English.

3.1.4 Step 4: Searching for literature. EBSCO information services, Google Scholar, Emerald, Web of Science, Business Source Premier and NGO Reports were used to search for the appropriate literature. To extract the research papers, the key search terms were decided. Boolean operators were used to combine the search terms. Combinations of two sets of keywords were used, including the following: humanitarian operations, big data, impact, developing economies, BDA, competitive advantage, operations management, supply chain management, humanitarian logistics, developing countries, natural disasters, humanitarian organizations, Red Cross, and resource management. Keywords were searched within the title, abstract, and keyword sections of the manuscripts. Overall, the use of these databases ensures the reliability, validity, and timeliness of the articles retrieved (Law et al., 2016).

Summary of Literature Review Articles

Author (s)	Journal Articles	Title	Notes on the study	Themes	Included	Excluded
Besiou and Van Wassenhove, 2020	*Manufacturing & Service Operations Management*	Humanitarian operations: A world of opportunity for relevant and impactful research	Organisations make use of big data tools and techniques that aid in business development.	Theme 1: Use of big data techniques in disaster relief operations	✓	
Gupta et al., 2019	*Annals of Operations Research*	Big data in humanitarian supply chain management	The integration of big data within the supply chain networks are useful in bringing in coordination and collaboration within the supply chain network. Humanitarian operations work consistently to save lives of individuals using scarce resources and competing with donors for capital.	Theme 1: Use of big data techniques in disaster relief operations	✓	
Lashgari et al., 2016	*Annals of Operations Research*	Partial up-stream advanced payment and partial down-stream delayed payment in a three-level supply chain.	organizations require information in order to proceed with their tasks. With an increase in data development analytics the supply chain systems in the humanitarian areas benefit with big data advancements.	Theme 1: Use of big data techniques in disaster relief operations	✓	
Dubey et al., 2018	*The International Journal of Logistics Management.*	Big data and predictive analytics in humanitarian supply chains.	Big data has played an instrumental role in the decoding of systematic flaws that are witnessed during disaster relief.	Theme 1: Use of big data techniques in disaster relief operations	✓	
Kaplan and Haenlein, 2010	*Business horizons*	Users of the world, unite! The challenges and opportunities of social media	Humanitarian roles and operations are accurately using micro tasking and social media by volunteer organizations for timely and cost-efficient data collection.	N/A		✗
Larson and Foropon, 2018.	*International Journal of Production Research*	Process improvement in humanitarian operations: an organisational theory perspective.	These humanitarian operations often operate in unique and uncertain environments and are faced with a change in the daily operational needs of the companies.	N/A		✗
Fadiya et al., 2014	*Procedia Engineering*	Advancing big data for humanitarian needs.	Public government and humanitarian organisations have adapted to the huge possibilities of big data to meet the needs and demands of data available to them to scientifically assess their validity.		✓	
Chaudhri 2017	Health Cluster	Humanitarian programming and monitoring in inaccessible conflict settings	Data and information are fundamental in humanitarian operations as data mining, contingency planning and other factors are looked after by the role of data analytics. The use of big data has been advanced for meeting humanitarian needs as with the massive increase in texts, emails, and images, it	Theme 1: Use of big data techniques in disaster relief operations	✓	

			is important for organisations to be able to synthesise the information and use it systematically.		
Ziora, 2015	*Procedia Computer Science*	The "role of big data" solutions in the management of organizations. Review of selected practical examples.	Technological innovation has brought in new insight for the growth and effectiveness of organisations. The integration of big data in humanitarian operations is instrumental as it leads to comprehension of authentic statistics that are significant for the comprehension of the research.	Theme 1: Use of big data techniques in disaster relief operations	✓
Belliveau, 2016	*Procedia engineering*	Humanitarian access and technology: opportunities and applications.	Humanitarian organisations have faced some barriers in time management and acquisition of vital information based on the collection of information of participants in the allocation of medical facilities and other items that were not readily available to the responders. These led to strategic mismanagement and issue of conflict between individuals.	Theme 4: Big data challenges faced by humanitarian organizations and solutions	✓
Luengo-Oroz, 2016	*UNHCR Innovation*	Big data science challenges facing humanitarian organizations	Some of the biggest challenges that are concerned in the scope of humanitarian organisations are the identification of the role of new data. The access to the data is a difficult process, as it does not relate to the development of data and innovation project. It is also challenging to be aware of the technical experts and the data translators that would be essential for the projects of the disaster relief operations.	Theme 4: Big data challenges faced by humanitarian organizations and solutions	✓
Ugwu and Onwuka, 2016	*International Journal of Research in Management, Science & Technology*	Humanitarian Organization: Effect of Collaboration between Different Agencies in Relief Operation.	There have been different agencies that have been working for the completion of the needs of those. These organisations include the Red Cross, World Food Program and so on. These organisations have contributed to the development in the living conditions of individuals in the affected areas.	Theme 3: Big data as a critical success factor for humanitarian operations	✓
Akhtar et al., 2012	*Journal of Humanitarian Logistics and Supply Chain Management*	Coordination in humanitarian relief chains: chain coordinators.	In the United States of America, for instance, therapeutic services and city experts in Durham County, North Carolina, chose to pool data to coordinate social and human services. They made an incorporated data framework that took	N/A	✗

			into consideration the coordination of endeavours to improve crisis division administrations and the consideration of patients with diabetes.		
Day et al., 2012	*Journal of Supply Chain Management*	Humanitarian and disaster relief supply chains: A matter of life and death.	There is frequently a confound between the data needs of the program and the limit of the related field staff to gather data with adequate quality for detailing, following, and more critically learning.	Theme 4: Big data challenges faced by humanitarian organizations and solutions	✓
Patel et al., 2015	*International Journal Data Mining Knowledge Management Process (IJDKP)*	Real time data processing frameworks.	Big data is hard to break down because it is unpredictable and hard to control.	Theme 4: Big data challenges faced by humanitarian organizations and solutions	✓
Bealt et al., 2016	*Journal of Humanitarian Logistics and Supply Chain Management*	Collaborative relationships between logistics service providers and humanitarian organizations during disaster relief operations.	Big data can be a fundamental apparatus in humanitarian reaction for associations and oversee since it enables responders to form bits of knowledge into humanitarian patterns. It can help recognize when and where individuals are needing alleviation or are in peril.	Theme 2: Use of big data in the supply chain networks of humanitarian operations	✓
Chen et al., 2016	*Clinical Therapeutics*	IBM Watson: How cognitive computing can be applied to big data challenges in life sciences research.	Big data incorporates data from sources that report progressively, which is otherwise unattainable from customary sources. It wipes out the need to store valid data for an all-inclusive timeframe to examine it sometime in the future. This additionally has an approach implication as deployment choices are verifiably formed on data that is a few years of age, so these choices would now be able to be made with current data.	Theme 3: Big data as a critical success factor for humanitarian operations	✓
Baack, 2015	*Big Data & Society*	Datafication and empowerment: How the open data movement re-articulates notions of democracy, participation, and journalism.	Interestingly, humanitarian organisations today have recently started neglecting the capability of big data to improve essential leadership. Estimating the effect of these data-driven choices will help present the defence for further interest in big data utilization.	Theme 4: Big data challenges faced by humanitarian organizations and solutions	✓
Pulse, 2012	*United Nations.*	Big Data for Development: Challenges & Opportunities	Data is generated all through our everyday lives, from using cell phones and online networking to merely shopping. Whenever broken down accurately, this data can be used to respond to numerous inquiries and give new experiences.	Theme 3: Big data as a critical success factor for humanitarian operations	✓

Arthur, 2013	John Wiley & Sons.	*Big data marketing: engage your customers more effectively and drive value.*	Big data can, in like manner, be used to foresee humanitarian emergencies. By observing sources, examples, and patterns, potential emergencies can be distinguished and turned away. These frameworks can likewise be used to improve future readiness by notifying individuals and looking for their direct input.	Theme 2: Use of big data in the supply chain networks of humanitarian operations	✓
Qadir et al., 2016	*Journal of International Humanitarian Action*	Crisis analytics: big data-driven crisis response.	Data generosity can impact both humanitarian endeavours just as our insight into the extent of big data. As the data philanthropy development continues extending, the tech business will hold focusing on the organizations that are the first to participate in this worldwide task.	N/A	✗
Thuraisingham et al., 2016	*IEEE International Parallel and Distributed Processing Symposium Workshops (IPDPSW*	Emergency-Driven Assured Information Sharing in Secure Online Social Networks: A Position Paper.	Online networking stages, for example, Twitter, Instagram, or Facebook, can help make a future where the flare-up of malady or debacle can be immediately seen and avoided. They can likewise help distinguish where the spread of destitution can be halted. For these to be accomplished, little humanitarian activities should work together with more prominent companies that are responsible for broadcast communications and enumeration data.	Theme 1: Use of big data techniques in disaster relief operations	✓
De Gregorio and Ranchordás, 2020	*Legal Challenges of Big Data*	Breaking down information silos with big data: a legal analysis of data sharing.	Approaching data and breaking down such data with creative data science and data ops apparatuses is not simple. It very well may be hard to consult with data suppliers, and companies may not be eager to take an interest because of protection reasons.	Theme 4: Big data challenges faced by humanitarian organizations and solutions	✓
Hussain, 2015	*International Journal on Future Revolution in Computer Science & Communication Engineering*	Importance of Big Data to Business World & IT.	The term big data alludes to massive datasets that must be prepared by PCs, instead of people, to uncover bits of knowledge.	N/A	✗
Ferguson and Soekijad, 2016	*Journal of Information Technology*	Multiple interests or unified voice? Online communities as intermediary spaces for development.	Data specialists make the visuals; topic specialists do the examination.	N/A	✗
Delanoy and Kasztelnik, 2020	*Business Ethics and Leadership*	Business Open Big Data Analytics to Support Innovative Leadership and Management Decision in Canada.	There are countries like Canada that have utilised big data and its analysis within their business systems. This will also be beneficial for	N/A	✗

Author, Year	Journal	Title	Findings	Theme	Included
			developing countries to adopt.		
Hilbert, 2016	*Development Policy Review*	Big data for development: A review of promises and challenges.	countries have adopted the utilisation of big data analytics as it serves as a cost-effective piece to accrue to the development of humanitarian operations. Developing countries have adopted the use of big data for reduction of environmental concern and have acquired value within organisations. Countries such as Kenya and South Africa are utilising big data within their business organisations.	Theme 3: Big data as a critical success factor for humanitarian operations	✓
Unctad.org. 2020	https://unctad.org/en /PublicationsLibrary /tir2018_en.pdf	Technology and innovation report 2018. Harnessing frontier technologies for sustainable development	Some countries have made use of big data for the procurement of sustainable development goals, which is essential for the business operations. Most of the countries have utilised big data for bringing in social change within countries.	Theme 1: Use of big data techniques in disaster relief operations	✓
Chaudhuri and König, 2018	*Contemporary South Asia*	The Aadhaar scheme: a cornerstone of a new citizenship regime in India?	A standout amongst the most encouraging instances of big data in worldwide wellbeing may rise out of India's yearning individual recognizable proof program. Since 2010 the administration of India has been issuing Aadhaar cards and one of a kind recognizing numbers to all 1.2 billion of its natives	N/A	✗
Jones et al., 2019	*JMIR mHealth and uHealth*	Toward an ethically founded framework for the use of mobile phone call detail records in health research.	The legislature of Côte d'Ivoire agreed to the arrival of five months of anonymized cell phone data. These data were then used to build up a model for containing the spread of epidemics. This sort of data charity or freedom in which corporate substances or governments share anonymized data of potential general wellbeing hugeness may give new cooperative energies between different partners.	Theme 3: Big data as a critical success factor for humanitarian operations	✓
Gharaibeh et al., 2017	*IEEE Communications Surveys & Tutorials*	Smart cities: A survey on data management, security, and enabling technologies.	The big data approach intrinsically requests progressively specialized aptitudes, specific hardware, interoperability norms, intelligent data accumulation, and examination frameworks, and administrative oversight.	N/A	✗
Mark et al., 2016	*F1000Research*, 5.	Better outcomes through learning, data, engagement, and research (bolder)–a system for improving	Even though the pooling of data crosswise over frameworks displays some significant snags, there are rising indications of data	N/A	✗

Author, Year	Source	Title	Summary	Theme	Included
		evidence and clinical practice in low- and middle-income countries.	possession in some low-and-middle salary nations.		
Athanasia and Stavros, 2015	The 12th International Conference on Information Systems for Crisis Response and Management.	Twitter as an instrument for crisis response: The Typhoon Haiyan case study.	The basic data instruments used in the post-calamity scene became an integral factor amid Typhoon Haiyan which brought about broad decimation to the Philippines in 2013. Help bunches used the devices in checking tweets just as texts where the foundation exists to help them. Local news provides details regarding the ground were additionally followed to discover regions that are experiencing the most severe harm with the goal that resources could be coordinated to those regions out of luck.	N/A	✗
Gupta et al., 2019	*Annals of Operations Research*	Big data in humanitarian supply chain management: A review and further research directions.	The accessibility of data is essential in improving the endeavours of activities after the event of a debacle. Data charity likewise helps in streamlining the administration and counteractive action of emergency using data preparing apparatuses to react to crises.	Theme 4: Big data challenges faced by humanitarian organizations and solutions	✓
Mulder et al., 2016	*Big Data & Society*	Questioning Big Data: Crowdsourcing crisis data towards an inclusive humanitarian response.	Big data can help make a more precise image of the provincial impacts of a debacle. The reports sourced from observers by Ushahidi after the 2010 seismic tremor in Haiti uncovered where the exploited people were covered under the crumbled structures and the regions where help was generally required	N/A	✗
Liu, 2014	*Computer Supported Cooperative Work (CSCW)*	Crisis crowdsourcing framework: Designing strategic configurations of crowdsourcing for the emergency management domain.	After the event of Typhoon Bopha in the Philippines, more than 20,000 online networking messages were used by the Digital Humanitarian Initiative to make a guide that uncovered the effect the tempest had and to decide the territory in critical need of help	N/A	✗
Acharya, 2016	Tribhuvan University Kirtipur, Kathmandu	*Socio-Economic Impact of 2015 Earthquake in Nepal*	Five years after the earthquake in Haiti, Nepal has been hit by two notable earthquakes, barely interrupted. The first, on April 25, 2015, reached a magnitude of 7.8 on the Richter scale and the second, on May 12, reached 7.3	N/A	✗
Meier 2015	Crc Press.	*Digital humanitarians: how big data is changing the face of*	The massive provision of data has now been indeed implemented in a disaster context but to a large extent led by public data activists,	N/A	✗

Soden and Palen 2014	Springer, Cham.	*humanitarian response.* From crowdsourced mapping to community mapping: The post-earthquake work of OpenStreetMap Haiti.	rather than formal humanitarian organizations the World Bank has been doing effective work in support of public data provision activities towards a humanitarian guide. Undoubtedly, two of the three activities examined in this segment, KLL, and Code for Nepal, are (implicitly) related to the World Bank, since the establishment of individuals and current pioneers in these associations also works for the World Bank. The critical exercise for the World Bank, which depends on the organization of the public stages of data provision in Haiti, was that the viability and maintenance of this methodology depended to a large extent on the ownership of the data.	N/A	✘
Wang et al., 2016	*International Journal of Production Economics*	Big data analytics in logistics and supply chain management: Certain investigations for research and applications.	Big emergency data alludes, essentially, to big data gathered amid emergencies or mass crises. Big emergency data, much the same as big data, can be of two sorts: organized and unstructured with the last being transcendent.	N/A	✘
Akter and Wamba 2016	*Electronic Markets*	Big data analytics in E-commerce: a systematic review and agenda for future research.	It has been proposed that the biggest hole in big emergency data informatics right now is in the extraction of organized data from the large measure of unstructured data. Big data is still difficult to find inside the Red Cross.	Theme 4: Big data challenges faced by humanitarian organizations and solutions	✔
Boccardo and Tonolo 2015.	*Engineering Geology for Society and Territory-Volume*	Remote sensing role in emergency mapping for disaster response.	Emergency mapping technology has developed in the previous five years as an apparatus to enable humanitarian associations to convey help to casualties of frequent clashes and cataclysmic events	Theme 3: Big data as a critical success factor for humanitar ian operations	✔
De Silva and Prustalis 2010.	*ICT for Disaster Risk Reduction*	The Sahana free and open-source disaster management system in Haiti.	Emergency mapping stages show observer reports submitted through email, instant message, and online networking. The stories are then plotted on intuitive maps, making a geospatial record of occasions continuously. The origin of these humanitarian innovations was controlled by free, public-source programming created by associations, for example, InSTEDD, Sahana, and Ushahidi.	N/A	✘
Boccardo, 2013	*European Journal of Remote Sensing*	New perspectives in emergency mapping	The pioneers behind the first wave of emergency mapping	Theme 3: Big data as a	✔

			technology were regularly skilled programmers from the dynamic public-source network. Making the up-and-coming age of these innovations will require extra abilities in data analytics, automated reasoning, Artificial intelligence (AI), and social figuring. This sort of skill exists today in world-class investigation establishments staffed by specialists who have the courage to complete front line Research and development in various territories of cutting-edge processing.	critical success factor for humanitar ian operations	
Purkayastha and Braa, 2013	*The Electronic Journal of Information Systems in Developing Countries*	Big data analytics for developing countries–using the cloud for operational BI in health.	Most developed countries have undertaken the use of big data for sustainable development. These countries derive economic value such as creation of new industries and manufacturing market.	Theme 3: Big data as a critical success factor for humanitar ian operations	
Spratt, 2015	IDS Policy Briefing 107, Brighton: IDS	Ensuring Developing Countries Benefit from Big Data.	Big data provides increased ability to connect and interact within market operations. Big data accessibility and easy access to constructive management information permits organisations to perform better and comprehend the dynamics of confined field environments and there in return it makes possible better decision making which is essential.	Theme 3: Big data as a critical success factor for humanitar ian operations	✓
Long and Brindley, 2013	Accenture Development Partnerships.	The "role of big data" and analytics in the developing world: Insights into the role of technology in addressing development challenges.	Big data is directly making completely new sectors infrastructure and market that is predominantly imperative for developing countries and for the companies who are challenging straight data analysis vocation across the globe. This allows the companies to perform better, compete in broader market with developed companies, and create a new competitive advantage.	Theme 3: Big data as a critical success factor for humanitar ian operations Theme 2: Use of big data in the supply chain networks of humanitarian operations	✓
Sharma and Joshi, 2019	*Journal of Humanitarian Logistics and Supply Chain Management*.	Challenges of using big data for humanitarian relief: lessons from the literature.	There have been complexities that have been raised in the management of authentic data and lack of professional handling of the data during humanitarian relief. most of the aid agencies assess their performance based on financial execution and output rather than focusing on the impact and the influence of data.	Theme 4: Big data challenges faced by humanitarian organizations and solutions	✓

Darvazeh et al., 2020	*New Trends in the Use of Artificial Intelligence for the Industry.*	Big Data Analytics and Its Applications in Supply Chain Management.	Utilizing big data analytics in the supply chain management, has improvised logistics work in several humanitarian operations.	Theme 2: Use of big data in the supply chain networks of humanitarian operations	✓
Prasad et al., 2015	*Disasters*	Building disaster-resilient micro enterprises in the developing world.	Humanitarian service delivery in developing countries affects the security of millions of citizens vulnerable to the catastrophic incidents. Thus, these services require a range of subsequent activities to be established successfully, including material flow, information exchange and synchronized resource transfer.	Theme 2: Use of big data in the supply chain networks of humanitarian operations	
Wamba et al*.,* 2018.	*The International Journal of Logistics Management.*	Big data analytics in logistics and supply chain management.	Big data creates situational awareness to mitigate challenges in diverse contexts.	Theme 2: Use of big data in the supply chain networks of humanitarian operations	✓
Prasad et al., 2018.	Annals of Operations Research	Big data in humanitarian supply chain networks: a resource dependence Perspective	For humanitarian organizations operating in complex and dynamic environments, visibility of mission-critical assets and their allocation and coordination across affected populations represent a challenge. Therefore, real time access to information regarding the position and availability of these resources could be a part of the decision-making process	Theme 2: Use of big data in the supply chain networks of humanitarian operations	✓
Papadopoulos et al., 2017	Journal of Cleaner Production	The role of big data in explaining disaster resilience in supply chains for sustainability	Supply chain networks need to be efficient and responsive so that they can not only survive, but also thrive in the long run. Resilience includes the ability to grow, propagate, and adapt to a changing environment. Big data can be employed to understand resilience in supply chains.	Theme 2: Use of big data in the supply chain networks of humanitarian operations	✓

3.2 Literature Summary

Big data and humanitarian reactions can be well matched, allowing crisis management teams to better control some of the world's most pressing and serious humanitarian emergencies. Through these projections, associations such as the UN can make precise assessments regarding areas that need the most assistance. This is reflected in the UN's 7 billion Act, which identifies seven key issues for the globe's developing populace.

Data combination could likewise create fascinating knowledge. For example, one could envision overlaying new satellite symbols and seismological data with live data sources (UNCTAD, 2018). A responder could more precisely confirm the location of territories with the greatest need. Whenever a catastrophe strikes, alleviation organizations react better when they have a point-by-point mapping apparatus to identify specific locations. Nevertheless, often, dependable, exact maps are not accessible.

The literature review has provided a critical understanding of the role of big data in humanitarian operations. It has found that the role and operations of big data in humanitarian sectors are in demand, and some developing countries have resorted to using big data technologies for supply chain management, data mining, and other efforts.

3.3 Theoretical Framework

Theoretical frameworks within humanitarian logistics are still in the developmental stage, with researchers borrowing hypotheses from multiple disciplines (Jahre et al., 2009). Organizations engage in collaborations with external stakeholders to manage their dependency on critical resources. This research was guided by the RDT framework and ST.

3.3.1 Resource Dependence Theory (RDT)

Resource dependence theory explains how dependence on external resources relates to focal organizational actions, network exchanges, and outcomes (Aldrich & Pfeffer, 1976; Emerson, 1962). In other words, it is a theory of power and influence that originates due to resource dependence and external constraints. The theory focuses on collaboration between external stakeholders and humanitarian organizations to manage limited resources and transport them to emergency-stricken areas. Currently, information and access to it are a pivotal element of dependency on resources; this information comes from external stakeholders, such as government agencies or social networks, and humanitarian organizations must use it not only to deploy emergency or contingent operations, but also to plan, and they must be prepared to a degree that was not possible in the past (Jahre et al., 2009). The theory recognizes that resources, whether material or data, come from external agencies, and this creates interdependence with multiple stakeholders. The heart of the resource-based theoretical perspective is understanding this inter-relationship to achieve smooth operations and to deploy contingencies.

Heimovics et al. (1993) have used this framework in the non-profit sector to examine the role of leadership. Fraczkiewicz-Wronka and Szymaniec (2012) have compared the importance of internal and external resources for making strategic decisions. More recently, RDT has gained attention from researchers in the non-profit sector, especially in explaining organizational actions and performance. For instance, MacIndoe and Sullivan (2014) have recognized that resource dependence among actors explains the nature and frequency of the collaborative activities non-profit organizations (NPOs) undertake. Additionally, Prasad et al. (2018) have examined how RDT can explain the phenomenon of using big data in supply chains of the development sector with corresponding outcomes. In this study, this framework is used to demonstrate the potential of RDT to improve the understanding of cooperation between stakeholders regarding aid policy.

According to Macedo and Pinho (2006), RDT can explain non-profit organizations' (NPOs) market orientation practices. A noteworthy finding is a link between resources (e.g., the source and degree of resource dependence) and the focal organization's inclination to serve its funders (as opposed to its obligations to deliver services to beneficiaries). Silverman and Patterson (2011) have shown that NPOs' reliance on public funding and donor perceptions are linked to how they balance program-related activities with political or advocacy-related activities. The empirical findings show that maintaining NPO activities is linked to having a strong individual donor base. Maintaining a solid base of individual donors is critical to the long-term viability of organizations and their activities. A significant individual donor base also implies power asymmetry among the focal and nodal actors. This disparity could have an impact on accountability and information expectations.

Donor power may influence non-profit reporting quality and the adoption of various performance indicators, such as outcome measurement (MacIndoe & Barman, 2013). Prior research (e.g., Nikolic & Koontz 2008; Verschuere & De Corte 2014) has indicated that public funding reduces NPO decision-making autonomy. Philanthropic financing from private and/or for-profit entities also shapes NPOs. Private philanthropic support has been positively associated with the effectiveness of non-profit boards, leading to enhanced fiscal control, according to Hodge and Piccolo (2005). Seo (2011) has investigated the relationship between various organizational behaviors and resource dependence patterns (RDP) in NPOs and found that resource diversity and competition have a direct impact on NPO outcomes. The source of resources has a significant and widespread impact on the organizational behaviors, actions, and structures of non-profits. For example, a higher degree of hierarchy and data formalization was found to be positively associated with a high resource dependency on government financing.

According to Paulraj and Chen (2007), organizations can improve inter-firm cooperation among supply partners in the face of supply chain unpredictability by understanding and accepting resource dependence concepts. This study uses RDT to demonstrate how supplier coordination and relationship-specific assets can help reduce supply chain risks. Power in supply chains can influence data flows, qualities, and expectations, and considerable power imbalances are possible among supply chain participants (Brown et al. 1995). As this helps integrate multiple aspects of the supply chain (Maloni and Benton 2000), pressure that one dominant nodal actor appropriately exerts can boost coordination among supply chain partners, resulting in improved operational outcomes (Brown et al. 1983). When one party has proprietary materials and networks (Webster 1995) and can manage uncertainty (Maloni and Benton 2000) and supplier dependency (Awaysheh and Klassen 2010), power can be wielded. These factors, however, may differ in the development sector.

Additionally, NGOs regularly apply BDA to manage multi-value humanitarian services along their supply network. According to Wamba et al.'s (2015) classification framework, big data has five properties: volume, variety, velocity, veracity, and value. In the for-profit sector, the usefulness of this classification paradigm is well established (Gogia et al., 2012). Wamba et al. (2015) present a case study on the use of BDA in humanitarian aid. Big data analytics has the potential to change how NGOs distribute humanitarian aid. Prior to a planned intervention, the main NGO and key stakeholders must determine which vital data qualities that need to be generated for that type of intervention. Furthermore, the types of expected outcomes (e.g., deliverables, costs, lead-times, and resilience) must be understood. Finally, crucial resource providers must exert pressure on the target NGO to ensure that the desired data qualities are created to achieve superior humanitarian outcomes. Big data analytics (particularly the value attribute)

necessitates a level of information technology and statistical skill that many NGO staff may lack, making it impossible for them to provide the data streams required by the relevant nodal actors. Training programs and instructional modules could be developed to provide the necessary skill set to NGO workers.

3.3.2 Stakeholder Theory (ST)

The role of private stakeholders in disaster operations goes far beyond the delivery of profits to shareholders (Fontainha et al., 2016). Stakeholders are defined as "all groups or individuals that affect or are affected by the business" (Freeman, 1984, p. 46). The humanitarian aid supply network consists of more than just "humanitarian" organizations. Kovacs and Spens (2008) list groups such as donors, aid agencies, NGOs, governments, the military, logistics service providers, and suppliers as actors involved in the humanitarian aid supply network. Oloruntoba and Gray (2006) have added aid recipients (beneficiaries) to the list while stressing the distinction between international and national, including community-based organizations. Van Wassenhove (2006) has also identified the media as a stakeholder of disaster relief.

According to ST, an organization essentially consists of its relationships with its stakeholders. The central objective of ST is to expand the idea of an organization's function, which is often considered the property of its owners (shareholders in public corporations) and has limited liability for its effects upon others (Freeman et al., 2010). In this sense, the theory generally considers the relationships among stakeholders to be the primary object of analysis and holds that they have a direct and dyadic connection. However, some studies have identified other complex relationships among them, such as an intermediary role in the flow of resources (Frooman, 1999), influence (Rowley, 1997), identity (Rowley & Moldoveanu, 2003), and ideas (Friedman & Miles, 2002). Media is an example in which this relationship is observed in disaster and humanitarian

operations, mostly because its function is to provide communication between two or more stakeholders, although it has its own environment, pressures, values, and ambitions (Friedman & Miles, 2006).

Although the responsibility for action in humanitarian operations is traditionally attributed to the public sector (Perry and Mankin, 2005), other sectors are also sometimes directly or indirectly involved. This collaboration is increasingly recognized as fundamental to achieving high efficiency levels in operations throughout the disaster life cycle (Schenker-Wicki et al., 2010). More specifically, humanitarian operations are designed to meet various demands of the population affected by disasters, such as immediate search and rescue, medical treatment, the provision of shelter, basic supplies such as water and food, special supplies such as clothing, essential services, infrastructure reestablishment, and productive/commercial activities reestablishment (Bastos et al., 2014; Blecken, 2010). In these operations, responsibility is shared among different decision-makers throughout the response and recovery period, preceded by plans developed in mitigation and preparedness stages.

All groups or persons who affect or are affected by the business are referred to as stakeholders (Freeman, 1984). The literature on disasters and humanitarian operations recognizes the role of stakeholders throughout the disaster lifecycle. The role of corporate stakeholders in disaster relief efforts involves much more than merely delivering money to shareholders. Fontainha et al. (2015) have created the social-public-private partnership (or S3P) stakeholder model for catastrophe and humanitarian operations shown in Figure 1.

Figure 1.

S3P stakeholder model of disaster and humanitarian operations
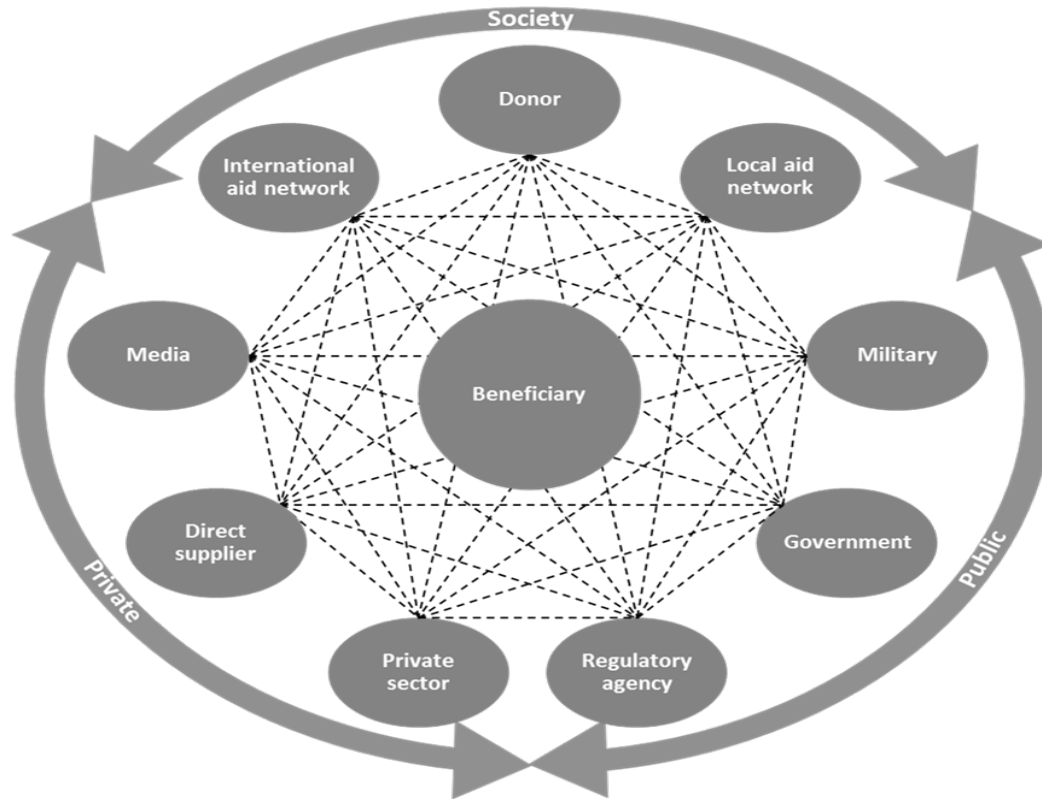
Note. The S3P aims to highlight three key characteristics of stakeholders' relationships: the central perspective of beneficiaries, the inherent fragility of their relationships (represented by dashed lines), and the fact that all stakeholders have multiple connections, including dyadic and other complex relationships. Adapted from Fontainha, T. C., de Oliveira Melo, P., & Leiras, A. (2016). The role of private stakeholders in disaster and humanitarian operations. *Journal of Operations and Supply Chain Management*, *9*(1), 77-93.

MacManus and Caruson (2011) and Nirupama and Etkin (2012) have emphasized the importance of forming a collaborative partnership between the public and private sectors, but they also note that not all partnerships are equally effective because managing different cultures, laws,

interests, and organizational resources can be difficult. The objective of purchasing in humanitarian operations, according to Blecken (2010), is to guarantee that humanitarian organizations have the resources they need to meet the demands of the operations they undertake. According to Ertem and Buyurgan (2010), the purchasing function is critical in disaster response operations since pre-positioned stockpiles and material donations are insufficient to cover all the demand.

International and local aid networks and the government itself are responsible for purchasing in the humanitarian chain (Taupiac, 2001; Balcik et al., 2010). According to Herlin and Pazirandeh (2012), the humanitarian chain has two types of purchasers: large buyers, like multinational NGOs and developed-country governments, and small buyers, such as local NGOs and developing-country governments. Major purchasers have a high number of purchases, operations in numerous disasters, a global reputation, well-known brands and legitimacy, high purchasing power, and an interdependent relationship with global suppliers. On the other hand, small buyers frequently face a small number of suppliers in the local markets in which they operate, are highly reliant on these suppliers, and hence have limited purchasing power. According to Herlin and Pazirandeh (2012), many humanitarian organizations have conducted strategic processes to identify and develop their core competencies. They have thus outsourced more and more activities, resulting in a restructuring of their purchasing areas, which now play a strategic role within these organizations.

In disaster and humanitarian operations, this form of interaction can be seen in the media, primarily because its job is to facilitate communication between two or more stakeholders that have unique surroundings, pressures, values, and objectives (Friedman & Miles, 2006). From this standpoint, corporate social responsibility (CSR) expands on the ST by stating that businesses

should behave in the best interests of all stakeholders, not just the financial ones (Freeman et al., 2010). The concept of reputation capital, which is defined as a collective creation that describes the combined perceptions of multiple stakeholders regarding a company's performance and the stakeholders' overall assessment of a company over time, is one reason to justify private stakeholders' involvement in social issues (Petrick & Quinn, 2000). Some authors (Van Wassenhove, 2006; Binder & Witte, 2007; Maon et al., 2009; Maether, 2010; Tomasini, 2011) have utilized the concept of CSR as a rationale to motivate and justify private sector participation in disaster relief efforts and to increase their involvement in the humanitarian supply chain.

However, some corporations may respond to social issues only after their stakeholders force them to do so (Russo & Perrini, 2010). These companies would engage in particular activities in humanitarian logistics rather than committing to the entire operation or long-term collaborations. Small local businesses, for example, are the first responders and are acknowledged as critical in the delivery of medication, food, shelter, debris removal, road repair, and other necessities in the aftermath of a disaster (BCLC, 2012). Ingirige and Wedawatta (2014) have noted that these companies use a one-off relationship approach, which is adapted from a wait-and-see approach to mitigation and preparation. This strategy is entirely focused on responding to societal challenges such as environmental degradation, natural resource scarcity, social inequity, and consumer expectations (Menz, 2012).

Other companies incorporate CSR concepts into their business strategies and consistently engage in social issues that affect one of their stakeholders. In humanitarian operations, these companies choose the CSR partnerships approach. This approach is characterized by a maturity level in which, organizations decide as part of their goals, to develop actions that can improve their image for stakeholders to boost sustainability (Wikström, 2010). Furthermore, the motivation

for engaging in a CSR associated with disaster operations and humanitarian logistics from small and medium enterprises depends on the perceived exposure of the business location to natural hazards (Herbane, 2015; Yoshida & Dayle, 2005). In this situation, companies more deeply involved in disaster and humanitarian operations also develop long-term partnerships, such as those among transportation companies (TNT, Agility, and UPS) and humanitarian organizations (Logistic Cluster, World Food Program, and World Economic Forum; Gatignon &Van Wassenhove, 2008; Gatignon & Van Wassenhove, 2009; Stadtler &Van Wassenhove, 2012a; Stadtler & Van Wassenhove, 2012b).

In comparison, Tomasini (2011) has used the CSR concept to analyze how companies can improve their commercial operations by learning from and working with humanitarian organizations. When the company meets the demands of its stakeholders, their perception of it improves, thereby improving corporate reputation. Being engaged in CSR activities can help manage reputational risk; it can also generate reputational capital and enhance performance (Fombrum et al., 2000). Corporate social responsibility states that the company is responsible for meeting the needs of everyone its operation affects. Thus, companies must act not only to avoid the pressures exerted by internal stakeholders, but also to achieve a greater good in society (Russo & Perrini, 2010).

3.4 Chapter Summary

This chapter identifies and discusses the existing literature on big data and humanitarian operations in developing countries. The table shows 33 related articles that were included for further analysis. The systematic literature review process here details the initial four steps that the researcher followed in the review process. First, the purpose of the review was identified;

second, a review protocol was developed. Third, the researcher identified the inclusion and exclusion criteria for relevant publications. An in-depth search for studies was then performed, and the two theories that guided the research were analyzed. Resource dependence theory was defined as collaboration between external stakeholders and humanitarian organizations to manage and provide limited resources to emergency-stricken areas (Prasad et al., 2018). Stakeholder theory, meanwhile, holds that the role of corporate stakeholders in disaster relief efforts involves more than delivering money to shareholders (Freeman et al., 2010).

4.0 Chapter Four: Methodology

It is noteworthy that the researcher in this study emphasizes exploring the role of big data in humanitarian operations in different countries. The problem statement in this study's first chapter notes that the researcher here explores the overall or holistic role of big data for different purposes and activities associated with humanitarian operations. This chapter provides the information to answer the research questions by analyzing and highlighting the researcher's approach to systematically solving the research problem. The research question is based on the aims and objectives of this thesis, which are described in chapter one. To meet the study's aims and objectives, the research framework and approach, philosophy, research design, and data collection and analysis methods are described in this chapter. The most appropriate methods are explained and justified. Finally, this section further highlights the limitations of conducting the research.

4.1 Research Framework

Saunders and Townsend (2016) have established a framework for assisting researchers to conduct studies in an organized and logical manner, addressing all the elements required to ensure a study's success. Their framework provides a systematic path for the researcher to select and implement the correct methods. Like the layers of an onion, the theorists created layers in this framework to indicate successive steps in the research. In this context, the researchers were guided by this framework and approached the study much like peeling an onion. By uncovering each layer of the framework, the researcher assesses the importance and selects the most appropriate research elements for the research context. For instance, the outermost cover of the research onion

framework consists of the epistemology and research paradigm, which guides the researcher's assumptions regarding data collection and analysis (Basias and Pollalis, 2018).

The layers in the framework include the research philosophy, research approach, research strategy, choices, time horizons, and, finally, the specific techniques and procedures for data collection and analysis (Saunders and Townsend, 2016). Further, the framework indicates that the researcher should select a philosophical stance in the first stage of research. The data collection and analysis methods, meanwhile, are in the core layer of the framework, which indicates that these methods are the most important in the study. The researcher must select these after considering all other research tools and elements to avoid errors.

4.2 Research Approach

The researcher selects the research approach to test the validity of the assumption or show how to establish a new theory based on the research. As per the research onion, this tool is as important as the research philosophy. Therefore, selecting the right approach helps the researcher gather the data required to identify the research issue and the solution. In this context, the researcher can choose a deductive or inductive approach to the study (Goldberg et al., 2017). The deductive approach enables knowledge creation from the general to the specific; in contrast, the inductive approach enables knowledge creation by exploring specific resources and moving towards a generalized notion. The deductive approach tests the validity of the hypotheses or assumptions based on the researcher's prior knowledge and then justifies it with the collection and analysis of empirical evidence. On the other hand, inductive research enables the researcher to contribute to the emergence of new theories. In this study, the researcher examines the role of big data on humanitarian operations, which requires exploring various sources and developing

knowledge based on prior assumptions about the positive impact of big data on humanitarian operations in different countries. Therefore, the researcher found the deductive approach more suitable than the inductive approach.

4.3 Research Design

Research designs have been defined in different ways in different academic contexts. For some, it is considered the method of choosing between qualitative and quantitative methods (Saunders et al., 2012). However, other evidence claims it is the specific method of collecting and analyzing data. The key elements of research design are the strategies and methods regarding data collection and analysis. The most commonly used strategies are exploratory, explanatory, and descriptive. The exploratory research design is utilized when it is necessary to develop overall knowledge on a research issue, with no or limited prior knowledge. This design enables researchers to explore several types of resources for collecting peripheral information and data to build knowledge (Haydon et al., 2018). On the other hand, explanatory research is mainly used to establish a cause-effect interaction within the main research elements or variables. The descriptive design allows researchers to conduct a study in depth or descriptively, without compromising its elements or quality. It also enables the use of both quantitative and qualitative data.

In this thesis, the researcher develops knowledge on the role of big data in humanitarian operations. Therefore, it is necessary to explore various resources to learn about different humanitarian operations and the related use of big data. It is impossible to collect such data through primary research, which is required to answer the research questions, as the problem covers a wider research area. Thus, aligning with the purpose, the researcher chose an exploratory research design.

In this study, the researcher focused on analyzing the role of big data in humanitarian operations. To explore the issue, it is crucial for the researcher to accumulate a high volume of information from diverse resources. This satisfies the need to follow the interpretive philosophy, as it assists the researcher in gathering subjective data in a qualitative form; this data can be analyzed in depth without statistical tools (Fletcher, 2017).

It is also important to select the right methodological design for collecting and analyzing data to meet the research needs; the possibilities are quantitative, qualitative, or mixed methods. Quantitative methods involve the collection of data from quantifiable sources that can be assessed using statistical data analysis (Humphries, 2017). On the other hand, qualitative methods consist of gathering data from high-quality and open-ended resources, and the resulting data is not quantifiable and cannot be analyzed with statistical methods. For the present study, as discussed above, a qualitative design was selected, as it helps produce a study with higher-quality data and improves the overall outcomes.

4.3.1 Research discipline

This thesis aims to develop knowledge with feasible applications for policy and practice (Kumar, 2018). This procedure involves research required to enhance existing social services or educational aspects. Such research is more common in the fields of social policy, social work, public health, juvenile and adult corrections, and criminology (Darian-Smith & McCarty, 2017). For this study, it was crucial to design research questions so that applied research could be included. The current study explores the use of big data, which is one of the main fields of applied research, and it has been found useful in diverse fields and humanitarian activities.

Humanitarian activities are also a key field of research that seeks to improve practices to safeguard the human population through effective resource utilization and protection (Maertens,

2018). This study thus aims to explain why big data is not used to address time and resource utilization issues in humanitarian activities. A systematic literature review was chosen examine why this is the case. An experiment or even a case study would be too narrow for this purpose.

4.4 Methodological Framework

Quantitative methods, as indicated above, involve numeric data. On the other hand, qualitative methods include data of high quality that are descriptive, and that the researcher cannot quantify. Both methods have potential advantages and disadvantages. According to Mohajan (2018), quantitative approaches offer a wide range of time-sensitive data collected in a simple way. On the other hand, qualitative methods offer in-depth and flexible data and include observation and objective data instead of relying on statistical methods. With this framework, the researcher can use a range of interpretive techniques, which can help demonstrate, translate, decode, and analyze the outcomes.

With qualitative methods, the data could be found and analyzed in terms of meaning rather than frequency. This approach increases the researcher's awareness of naturally occurring phenomena in the social world (Xiao & Watson, 2019). It is suitable for applied research, such as this study, as it seeks to identify data that can be applied for social issues. Therefore, based on the understanding of the methodological framework, the current research necessitated a qualitative methodological framework to gain the best possible data. The quantitative method is not appropriate, as the research objectives in this study concern a vast area of knowledge that must be analyzed and discussed in depth instead of relying on a statistical framework (Murshed & Zhang, 2016).

4.5 Data Collection Method

The data collection method is one of the most crucial aspects of the research methodology. The research onion framework places this tool at the core level, which indicates its importance; it further suggests that the researcher should consider all other research tools before choosing the method of collecting data (Saunders et al., 2012). There are two types of data collection methods: primary and secondary (Ngozwana, 2018). Primary methods are associated with extracting information from first-hand resources that have not yet been published. In contrast, secondary methods involve exploring the existing, already published research base (Ngozwana, 2018). Both methods have merits and disadvantages, and the researcher must choose the right method for the study.

This study explores a wide range of data to understand the use of big data in humanitarian activities. As the research aims to understand its use, it is crucial to explore existing resources that show how big data has been used in humanitarian activities. The secondary data collection method is thus suitable here to meet the research objectives, as it enables the researcher to examine diverse types of resources, including journals, articles, magazines, reports, and books (Wang et al., 2019). Primary data collection is not preferred in this study because of ethical concerns or accessibility issues due to the current pandemic.

The secondary data collection method used here is the systematic literature review. This process allows the researcher to find key resources using search criteria and then critically appraise the literature to extract the required data (Okoli, 2015). Secondary data were gathered from books and resources from the UNBC library, research journals, government reports, fact sheets, NGO reports, and online databases, including EBSCO Information Services, Google Scholar, Emerald, Web of Science, and Business Source Premier.

The systematic literature review process consisted of the following eight steps, as indicated by Okoli (2015).

Step 1: Identifying the purpose. The key purpose of conducting this review was to explore the role of big data in humanitarian operations. The following review was conducted for this purpose.

Step 2: Drafting protocol and training the team. The research team consulted the detailed draft protocol for the systematic review, and the committee members were briefed on the researcher's role.

Step 3: Applying practical screen. The inclusion and exclusion criteria applied practical screening to the identified literature and were related to the role of big data in humanitarian operations.

Step 4: Searching for literature. EBSCO Information Services, Google Scholar, Emerald, Web of Science, Business Source Premier and NGO reports were used to identify the relevant literature.

Step 5: Extracting data. The researcher systematically extracted the required data from the identified resources.

Step 6: Appraising quality. Quality appraisal for the literature was done using the critical appraisal skills program (CASP) checklists. These are a series of specification questions that help evaluate the checklist.

Step 7: Synthesizing studies. Finally, data was synthesized following appropriate analysis techniques, including thematic analysis.

Step 8: Writing the review. After following the above principles and obtaining the necessary data a review was written regarding the defined themes.
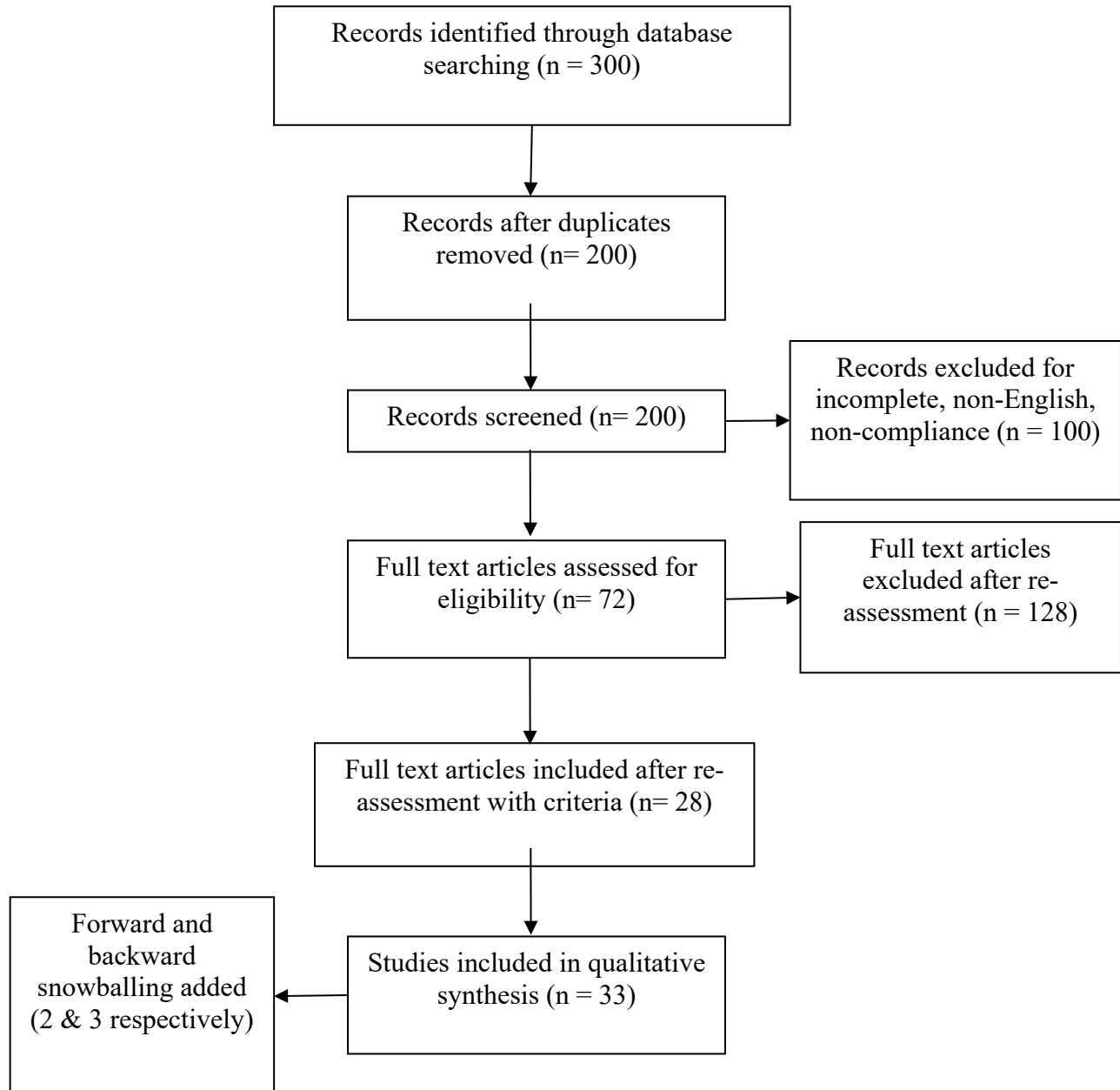
4.6 Sample/Data and Sampling Method

It is crucial to ensure that the researcher collects the sample from the target population; this ensures that the target is represented and reduces the complexity of analyzing data. In this study, as secondary data collection and analysis were selected, the data were subjected to a non-probability sampling method, as high-quality secondary data have been collected selectively (Randolph & Justus, 2009). The researcher used key search terms in the identified databases to access the most appropriate data; these included "humanitarian operations,"" big data," "impact," and "developing economies." These search terms were joined using Boolean operators for a more refined search process. Further, the researcher identified key inclusion criteria to select appropriate literature for the study (Timmins et al., 2005):

- Only literature focusing on big data within humanitarian operations management

- Literature published no more than 10 years ago

- Literature published in English

- Literature with free full-text availability

Figure 2

PRISMA flow chart

```
┌─────────────────────────────────────┐
│   Records identified through database │
│         searching (n = 300)           │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│     Records after duplicates          │
│        removed (n= 200)               │
└─────────────────────────────────────┘
                  │
                  ▼
┌──────────────────────────┐      ┌──────────────────────────┐
│  Records screened (n= 200)│─────▶│   Records excluded for    │
│                           │      │  incomplete, non-English, │
│                           │      │ non-compliance (n = 100)  │
└──────────────────────────┘      └──────────────────────────┘
                  │
                  ▼
┌──────────────────────────┐      ┌──────────────────────────┐
│  Full text articles       │─────▶│    Full text articles     │
│  assessed for             │      │    excluded after re-     │
│  eligibility (n= 72)      │      │   assessment (n = 128)    │
└──────────────────────────┘      └──────────────────────────┘
                  │
                  ▼
┌──────────────────────────┐
│ Full text articles included│
│  after re-assessment with  │
│     criteria (n= 28)       │
└──────────────────────────┘
                  │
                  ▼
┌──────────────────────┐      ┌──────────────────────────┐
│  Forward and          │◀─────│  Studies included in      │
│  backward             │      │  qualitative synthesis    │
│  snowballing added    │      │      (n = 33)             │
│  (2 & 3 respectively) │      │                           │
└──────────────────────┘      └──────────────────────────┘
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Note. The search was initiated on June 5, 2019 and ended on February 20, 2021. As seen in Figure 1 (PRISMA flow chart), at stage 1, 300 papers were identified and entered in the reference manager. At stage 2, the author reviewed the titles of the studies of stage 1 to determine their relevance to the systematic review. At this stage, studies that clearly did not address the humanitarian aspects of big data were excluded, regardless of whether they were empirical. In addition, articles on big data in developed countries and or duplicated articles were not included in the next stage.

Two hundred articles were retained after this process. In the third stage, all remaining articles were examined in terms of their abstracts and their focus in relation to the research questions. The abstracts were of different quality, some lacked information about the content of the article, and others had an apparent disconnect with their title and did not fit the focus. At this stage, the author independently reviewed each abstract; of these, 128 were omitted for being incomplete, not in English, or because they were not relevant to the study, leaving 72 papers. After a further reassessment, 33 papers remained. Adapted from Van der Deijl, M., Etman, A., Kamphuis, C. B., & van Lenthe, F. J. (2014). Participation levels of physical activity programs for community-dwelling older adults: a systematic review. *BMC Public Health*, *14*(1), 1-8.

4.7 Data Analysis Method

Following the research onion framework, the data analysis method is also located in the framework's core level, along with the data collection method, indicating their interdependence and a similar level of importance. The researcher must choose the data analysis method based on the data collection method and the study objectives. The primary methods usually include statistical tools to analyze numerical data (Snelson, 2016). In contrast, the secondary methods

usually include descriptive analytical tools to analyze open-ended, flexible, and richer data that requires analysis and interpretation.

In this study, the researcher followed the secondary research methods for data collection to meet this study's goals. Thematic analysis is a method for identifying, analyzing, and reporting patterns (themes) within data. It minimally organizes and describes a data set in detail. However, it also often goes further and interprets various aspects of the research topic (Braun & Clarke 2006). This method was chosen as a suitable tool to analyze the data collected from the systematic literature review process. This method enables the researcher to analyze all subjective data in depth and descriptively, to consider all variables, and to explore potential resources. A thorough analysis of data enables the researcher to find common patterns in the data, which are then sorted and analyzed under themes that emerge from the research.

Data reduction and theme identification were part of the data analysis procedure. The researcher conducted four rounds of data reduction and coding; each time, the codes were further refined by adding, subtracting, combining, or splitting them. During the first round, the researcher concentrated on keywords mentioned in at least one of the selected data sets. This resulted in 31 significant keywords and phrases, which were shaped by the overall research questions and objectives. During the second round of coding, the researcher reviewed the data sets again and looked for keywords that were cited in at least two of the articles. Next, the keywords were condensed into 17 codes.

The next step in the coding process was to identify patterns in the codes and condense them into themes. At this point, the researcher had a set of potential themes and reworked them into initial themes. Some were condensed into smaller units, and others were collapsed into each other. The researcher named and defined themes after finalizing those to be discussed. After the

final themes were reviewed, the researcher began the process of writing the final analysis. While writing the analysis and discussing the data, the researcher decided on themes that made meaningful contributions to answering the research questions; these were refined later as the final themes. During the final round of coding, the researcher decided on four primary themes that incorporated all the codes identified in earlier rounds and removed codes that were too ambiguous or that were unrelated.

4.8 Limitations of the Research

The researcher identified limitations to the research and ensured they were minimized, which Hair et al. (2011) have recognized as important. As with all research, the value of a systematic review depends on what is done, what is found, and the clarity of reporting. The quality of published literature varies limiting readers' ability to assess the strengths and weaknesses of those studies (Moher et al. 2009). Future researchers should be mindful, as several practical problems may emerge later, such as in the searching, screening, and synthesis stages. Moreover, systematic reviews require access to a wide range of databases and peer-reviewed journals, which can be problematic and expensive for non-academic researchers. Searching institutional websites, for example those of international organizations, is essential to ensure a broad scope of data that can be systematically reviewed. This allowed the researcher to access additional relevant studies from sources other than formal, academic, peer-reviewed channels. However, searching institutional websites undermines the objectivity of the search and retrieval process and introduces bias. To achieve objectivity, inclusion and exclusion criteria as applied by Okoli (2015) were used to screen potentially relevant studies.

Because the study was conducted during the peak of the Covid-19 outbreak and because of cost constraints, the researcher decided against travelling to several underdeveloped countries to conduct interviews. Although I initially thought that conducting interviews would be beneficial and provide more unique insight into the topic because firsthand data would be more generalizable, there are also complex ethical issues that the researcher must consider when conducting research during a global pandemic, and each methodological technique also entails ethical considerations. The participants' and researchers' health and well-being should take precedence over study timetables and thesis deadlines; accordingly, only a systematic literature review was conducted.

Furthermore, due to time and resource constraints, the thesis relied on the author's research design and results, which introduces another source of bias. In principle, systematic reviews should be supported with correspondence with the authors of the studies and the subsequent replication or reproduction of their results, which is often not feasible due to resource constraints. Duvendack et al. (2011) have highlighted the need for replication or reproduction, as even results from papers published in top-ranked peer-reviewed journals may not be reliable. The authors suggest that the availability of raw data to enable replication, repetition, and replication in other locations is desirable to assess the quality of studies. However, many authors may not be enthusiastic about detailed questioning of their work (see Duvendack 2010 and Duvendack and Palmer-Jones 2011 for their replication experience).

The systematic review process is extremely resource intensive. Using a rigid systematic review procedure is demanding and time-consuming, in part because of the high number of studies that are often assessed in the first stage of screening. This concern was addressed by outlining feasible timelines at the beginning of the project to allow sufficient time for each phase of the study. Here, for the review technique, the author adopted a clear, rigorous approach; however, as

a result, the process took longer than expected. For replication purposes for future researchers, it might be less time consuming if a team conducted the review process, and different researchers could be involved in performing the data collection independently. It would then be discussed with the research team, thus resulting in accurate and unbiased data.

4.9 Summary

This chapter focused on discussing and identifying the appropriate methods and tools for the current study. The researcher used the research onion framework to guide the research procedures and selection. The selected data collection methods were intensively evaluated, and the rationale was explained to enable effective data-gathering; the secondary data collection approach was adopted to achieve the aim and objectives of the study. The method utilized was the systematic literature review. This process allowed the researcher to find key resources using search criteria (Okoli, 2015).

The thematic analysis method was chosen to analyze the data collected from the systematic literature review process. Thematic analysis minimally organizes and describes a data set in detail. However, it also often interprets various aspects of the research topic (Braun & Clarke 2006). The purpose of the research was aligned with the selection procedure, and these secondary methods were suitable for the research objectives.

5.0 Chapter Five: Data Analysis and Discussion

This thesis analyzes how big data is used in humanitarian operations in different developing countries. The research first sought to understand why big data is used for humanitarian operations management, to explore areas in which big data is used for humanitarian activities, and, lastly, to examine the challenges associated with the use of big data. As research on big data is vast, this research relied on secondary data and used a systematic literature review, which assisted the researcher in identifying the literature that could answer the research questions. Data was collected from different sources and analyzed further with use of the thematic analysis method. This chapter focuses on the analysis and discussion of the interpretation of certain themes.

This study identifies four major themes that record how developing countries can implement big data to be applied in humanitarian operations. The findings from previous literature have helped show how big data is used for humanitarian operations in developing countries. To finalize the themes discussed in the review process, the researcher read and re-read the literature. While becoming familiar with the materials, the researcher employed notetaking to develop potential codes. Four themes identified in this thesis are discussed below: the use of big data techniques in disaster relief operations, the use of big data in the supply chain networks of humanitarian operations, big data as a critical success factor for humanitarian operations, and big data challenges faced by humanitarian organizations and solutions.

5.1 Theme 1: Use of Big Data Techniques in Disaster Relief Operations

Big data's role in disaster management is evolving. Researchers have faced significant challenges in managing and securing a large volume of data generated and distributed during disasters. However, the innovations in data management through BDA have provided the scope

for humanitarian organizations to direct and secure a large volume of data during disaster management. Humanitarian operations describe many disaster relief activities managed by governments and private or non-government organizations. As the resources required for such relief operations are expansive, coordination plays a vital role in their success. In this regard, Gupta et al. (2019) have noted that big data can help improve the logistics of relief efforts and increase preparedness, thereby reducing damage to the community and the loss of lives. For instance, one year after a hurricane in 2017, residents still sought recovery assistance, notwithstanding the $15.3 billion earmarked for relief efforts. Big data analytics have been identified as the key resource for disaster relief and preparedness in such contexts. It assists NGOs and other emergency responder agencies in recognizing and tracking communities seeking help and identifying the most vulnerable communities (Dubey et al., 2019). In addition to assistance with planning and resource management, these tools also promote real-time communication during disaster management and emergency. Organizations use big data to project residents' reactions and needs during a crisis, which improves the preparedness of humanitarian operations, thereby increasing the potential for success. A large volume of data collected and managed through BDA helps the managers of humanitarian organizations make correct decisions (Akter & Wamba, 2019).

Big data assists non-profit organizations in crisis mapping. For instance, in Nairobi, a non-profit data analysis organization, Ushahidi, created an open-source software platform to gather a wide range of information. Devised in 2008, this technology served as an interactive mapping platform to analyze violent areas subject to crisis after the presidential election of Kenya. The organization gathered information from social media and primary resources, which were then used with an interactive Google map to help citizens avoid risk. The organization modified this

technology during Haiti's earthquake to aid the effort to save citizens in that region. The crisis-mapping system of the organization helped the US Marine Corps find citizens, thereby making the rescue missions faster (Choi et al., 2018).

The use of big data systems helps humanitarian organizations forecast disaster-related information, which further enables the organizations to prepare communities for emergencies and be proactive in preventing the destructive consequences of disasters (Ayers, 2018). The organizations collect and combine data sets to use in scenario modelling and notification platforms for pre-emptive disaster management. Similarly, citizens in areas where organizations aim to provide disaster relief also contribute to disaster management systems by providing their information (Ayers, 2018). However, developing countries lack data scientists who could work with technologies; they could help during disasters with better information management through BDA.

Similarly, Papadopoulos et al. (2017) collected reactions from 205 managers engaged in disaster relief activities following the Nepal earthquake in 2015. The findings relied on big data to improve resilience in disaster supply chain networks to create sustainability. The results show that using big data improved resilience in the supply chain by developing trust among the public-private partnership, thereby leading to sustainability in relief works.

Location is a vital aspect in disaster communication and messages. Evidence shows that social media, including Facebook and Twitter, could reveal information about location during emergency situations. Additionally, data-mining techniques, e-commerce, and radio-frequency identification (RFID) can further contribute to developing the emergency database by extracting and recognizing important information from consumers' databases during an emergency (Akter & Wamba, 2019). The use of volunteered geographic information (VGI) has also shown the

importance of having volunteers develop a large volume and variety of spatial datasets from the public, both directly and through internet resources (Wang et al., 2016).

5.2 Theme 2: Use of Big Data in the Supply Chain Networks of Humanitarian Operations

Utilizing BDA in supply chain management has improved logistics work in several humanitarian operations. Humanitarian operations are highly regulated by NGOs, which use BDA to synchronize service delivery in the supply chain by aligning community needs with the available resources. Such operations have contributed significantly to mitigating the gap between theoretical implications and practical outcomes. Big data analytics have enabled humanitarian operative groups to balance demand and resources so that key inefficiencies can be easily tracked and managed (Dubey et al., 2018).

Humanitarian service delivery in developing countries affects the security of millions of citizens vulnerable to catastrophic incidents (Prasad et al., 2015.), and these services require a range of activities to be established successfully, including material flow, information exchange, and synchronized resource transfer. NGOs play a significant role in managing these activities in developing countries; they are responsible for identifying needs and ensuring the delivery of necessary humanitarian services through their effective human resources, and they must also be accountable to stakeholders regarding data flow (Prasad et al., 2018). These organizations are often associated with a range of value stream operations in diverse welfare areas, including healthcare, education, and income generation. As these value streams serve many people, these sectors usually involve data-intensive and data-centric activities. To perfect these operations, organizations have a significant opportunity to use BDA. They work with a broad network, and they have both a commitment to implement deliverables and an effective supply chain network,

which includes local communities and governments. These nodes require NGOs to deliver their promised outcomes, which encourages the organizations to use big data in their supply chain to deliver the promised outcomes at a given cost and within a certain period (Prasad et al., 2018).

Using BDA in the developmental sector is effective in transforming the capability of the NGOs working for humanitarian service delivery at a time-bound and cost-effective manner while ensuring long-term resilience. Today, NGOs explore data analytics to use this information as a strategic initiative and bring innovation to the supply chain procedures of humanitarian operations. Such initiatives can alter the nature of the developmental sector's ecosystem (Dubey et al., 2018).

Wamba et al. (2018) have argued that a key success factor for humanitarian operations is situational awareness, which can be achieved by observing contextual elements to develop predictions regarding imminent events. In this context, big data has immense potential to cultivate new organizational capabilities, adding value to existing practices and helping them mitigate challenges in diverse contexts.

Humanitarian service delivery can be viewed as a supply chain network. Although the NGOs manage the network, the organization interacts with several players within it to deliver the intended service outcomes. These players include local corporate donors, local companies, foreign donors, local councils, government bodies, banks, self-help groups, and government schools (Prasad et al., 2018). The entire humanitarian value stream depends on a specific set of players who are responsible for supplying tangible and intangible resources while expecting specific outcomes in return. Some NGOs supply diverse range of interventions with the help of big data solutions and expectations, which can augment the understanding about the relationship between big data, power, and resources, resulting in different humanitarian supply chains in developing countries (Prasad et al., 2018).

For instance, the Indian Pollution Control Association (IPCA) is an NGO working in the informal solid waste management sector in the National Capital Region of India to support rag-picker communities; it is also committed to improving overall recycling frequency. Meanwhile, the Hub-n'-Spoke is a focal NGO working for indigenous or tribal communities in rural Andhra Pradesh, India; it aims to provide adequate educational access to these disadvantaged communities. Sodhana Charitable Trust is another NGO in India and assists with the development of Dalits, a lower-caste community in a district of India (Prasad et al., 2018).

Analyzing the supply chain network of these NGOs reveals five key attributes of big data in the humanitarian sectors in developing countries: volume, variety, velocity, veracity, and value (Prasad et al., 2018). For the NGOs, the "volume of data" is smaller than the data required in the corporate sector; therefore, the need to track records has increased significantly. Working in a diverse field with diverse levels of stakeholders, these organizations must collect additional data fields in which big data can be helpful. The scope, scale, and sophistication of data collection have increased the need for a higher volume of data.

In the case of big data, variety is not only associated with the types of digital media, but also with types of languages. This variety includes items, verbal and non-verbal communications, and electronic forms. A wider variety of data needs to be collected in humanitarian supply chain networks that aim to use BDA (Stauffer et al., 2016). Furthermore, velocity is considered the rate at which businesses collect, retain, and handle data. For example, the amount of social media postings or search queries received in a given day, hour, or other time unit.. Big data analytics provides significant assistance through cloud computing and other tools to make procedures like land re-distribution issues easier and less complicated (Nagendra et al., 2020).

Another key big data attribute in humanitarian operations concerns the veracity of data. Data in humanitarian operations requires extensive cross-validation. Organizations require data with a high level of veracity to ensure, for example, the seamless micro-credit support of their self-help groups and to ensure the accuracy of individual records of low-caste communities (Araz et al., 2020). In the education sector, school officials need data to have high veracity to offer the necessary records required for admissions (Tiwari et al., 2018). In the healthcare sector, an array of data is required to collect health indicators and conduct health camps. This ensures that NGOs continuously receive funds and participate in humanitarian work with other NGOs.

Value is another key attribute of BDA, and it plays a vital role in the humanitarian supply chain operations of developing countries. In this regard, Wamba et al. (2018) have found that organizations encourage transparency, thus enabling testing, segmenting the population, and innovating new business models, products, or services using high-value data. This indicates that several value streams are involved in the humanitarian supply chain with a different set of data attributes. For example, the value streams of humanitarian networks emphasizing healthcare or education seek a higher volume of data, but, in the case of disaster relief value streams, a higher orientation towards velocity is found. For instance, a high volume of data is needed to collect children's health-related data while maintaining a large volume of records on students' attendance in the educational sector. The results show improved attendance with a reduced cost of operations along with higher retention. Meanwhile, using highly accurate data, the Hub-n'-Spoke network offered detailed records of spending on disaster relief following the consequences of the Hudhud cyclone (Comes, 2016). After this disaster, communication was disrupted, especially in remote areas. However, using big data, relief operations operated quickly. The team of

humanitarian workers used alternative ways to communicate and used various data sets via e-mail and social media. This improved the delivery of relief supplies to remote areas.

The use of big data in predictive analytics in the humanitarian supply chain was investigated by Dubey et al. (2018). They looked at whether big data and predictive analytics could be utilized as an organizational competency to improve coordination and visibility in the humanitarian supply chain using data from international NGOs. Predictive analytics techniques are used to estimate the consequences of events or operations by testing past data trends through statistical, programming, and simulation techniques (Behl & Dutta, 2019). In the developmental sector, it is crucial to predict some consequences so that organizations can be prepared to address possible consequences and ensure overall well-being through humanitarian activities. Similarly, as the humanitarian supply chain involves large numbers of transactions and inventory, keeping and maintaining records regarding the consequences of the operations is also important. Many companies use data analytics to optimize production and inventory (Swaminathan, 2018). As the humanitarian data set is large and requires high accuracy, speed, and diversity, big data and predictive analytics play a crucial role in maintaining the security of these data.

The findings of the study conducted by Dubey et al. (2018) revealed that big data and predictive analytics have a significant influence on the visibility and coordination of the supply chain network. In addition, the results also show that, with these methods, humanitarian organizations can develop trust quickly and thus improve visibility and coordination in the supply chain. Following Ali et al. (2016), the proliferation of digital platforms has brought growth within organizations. Efficiency in algorithms has been utilized to meet the coordination and visibility requirements in emergencies and other situations. To support this effort, Darvazeh et al. (2020) have proposed that NGOs can use BDA to make the supply chain network greener, thereby

contributing to the environment by reducing the risk associated with hazardous materials, carbon emissions, and overall costs. Using a big data approach, the quality of the data acquired could be managed.

Organizations collect a large amount of data to use predictive analytics, which is significant for their expansion and development. Therefore, by using big data, the humanitarian supply chain can draw on predictive analytics to accurately project and plan for disasters. Historical data can be deployed to acquire the necessary information, which would be instrumental in projecting future requirements for organizational operations. According to Jeble et al. (2016), algorithms have been updated and play an instrumental role in the effectiveness of humanitarian operations. Companies such as Amazon have also used BDA to increase their competitive advantage. The traditional data and values derived from social media add to the growth of the research. The digital revolution has brought into perspective the role of BDA to meet the needs and requirements of information management in large organizations. Some humanitarian actors have used predictive analysis to take anticipatory measures (Poole, 2019). Such measures are closely followed and led by technical specialists who participate in research.

5.3 Theme 3: Big Data as a Critical Success Factor for Humanitarian Operations

Big data has been identified as a critical success factor in humanitarian operations. However, with further improvement, there can be greater success in using big data during disaster relief. The role of humanitarian aid is to deliver improvements and increased attention to individuals who are struck by the onset of disaster and who are subjected to adversities. The humanitarian supply chain uses various factors to meet people's needs. According to Akter and Wamba (2019), one major critical success factor big data offers is its role in disaster management. BDA can visualize and

predict disasters that can upend the growth and development of business operations. Hence, it plays an important role in crisis management. The quantity of global disasters has resulted in a loss of property and infrastructure every year. Per Akter and Wamba (2019), the overall global economic losses amounted to 175 billion US dollars in 2016. The recurring impact of these disasters has led to a loss of developmental and progress factors in the nations affected.

Big data analytics has played an essential role in natural disaster management, and techniques have been discovered to search, organize, collect, and disseminate real-time disaster information to individuals. This helps organizations be aware of the management and disaster recovery tasks, which is significant for the development of operations. The increase in the use of social media, location-based frequencies, and BDA is helpful to the stakeholders in disaster management. Based on the literature review, BDA is the analysis and processing of the five Vs: variety, velocity, veracity, volume, and value. These are analyzed to discover actionable insights that lead to a competitive advantage in the industry. Thus, BDA plays a pivotal role in networks and energy communication and is paramount to understanding disaster-related sources and deploying optimal resources to acquire efficient results.

According to Beresford and Pettit (2019), big data is useful for humanitarian aid and the supply chain. Supply chains are responsible for meeting the needs and demands of a particular area. Big data analytics also plays a primary role in the management of the supply chain. The traditional database is uncomplicated and structured. According to Lashgari et al., (2016), most of the information collected concerning data management is stored in archives. The continuous creation of data means that viable management is required to categorize it. Further, it is necessary to examine collected data that is both structured and unstructured. One should be cognizant of the growth of the HADOOP big data analytics market, which is an instrumental part of increasing the

need for BDA (Lashgari et al., 2016). It is increasingly necessary to grow capabilities to analyze information extracted from the business arena. The commercial supply chain is confronted with several difficulties that result in voluntary information for the growth and operation of businesses. As a result, there is a constant flow of information interchange and the expansion of numerous activities. It is essential to be aware of the data-intensive operations that NGOs conduct.

Additionally, some NGOs have used BDA to determine a link between malnutrition, literacy, and agricultural data. Farmers can use big data to obtain detailed information on rainfall patterns, water cycles, and fertilizer requirements, allowing them to make informed judgments about which crops to sow for maximum profit and when to harvest. Farm yields are improved when the appropriate decisions are made. Data scientists can also compute the resiliency of a community subjected to disasters. Ample data is collected for analysis and can usually be identified as cross-functional. According to Gao et al. (2015), BDA has been instrumental in the research capabilities of organizations. Further, data warehouses have played an instrumental role in making sense of the data for these organizations.

Also, according to Susha et al. (2019), the emergence of new partnerships has brought favorable gains for humanitarian operations through data sharing. Furthermore, the exponential rate of ideas has increased as a result of the increase in data volume, which is favorable to humanitarian organizations' activities. Therefore, local partnerships have been created to increase the success of such operations. It should be noted that most societal challenges are also addressed with the emergence of social data and partnerships. Therefore, this partnership is favorable for such operations, as they can work together to support and add value during disaster relief.

A data-driven social partnership is a collaboration between actors in one or more sectors to leverage data from different parties at any stage of its lifecycle for public benefit in policy or

science as many pressing problems today cannot be solved by government, business, and civil society organizations individually. The increased availability of big data is one key ingredient in solving or managing such problems, as challenges in the field are many and diverse. The kind of data that can be exchanged depends on the specific interface of the organizations that pool resources in a partnership. It matters whether the actors are public, private, for profit, or non-profit. The challenge for relevant data-gathering is to create the right organizational fit between the participants and the problem to be addressed (Pfisterer & Van Tulder, 2014).

The topic that the partnership hopes to address frames the evaluation of its effectiveness. The more complex an issue is, the more important it is that the partnership measure indicators and develop joint indicators for impact in the longer run (Van Tulder et al., 2016). Data-driven social partnerships have the potential to exchange data at all these levels, provided the right conditions can be created for a trusting, goal-aligned relationship. The same applies to the challenge of jointly developing more data points in case of a joint societal goal (such as SDGs) and a formation process that builds up trust relations. Organizations can become more willing to share data and invest in each other's data collection abilities, thus creating the collective intelligence needed to make the partnership effective in the longer run (Patton, 2015).

Big data has influenced society by introducing various changes, which could be attributed to its growth. There is greater understanding of poverty reduction, climate change, and other factors associated with the development of the research. The collaboration between the different actors, also known as a data collaborative, is a new term (Patton, 2015). It concerns the usage and sharing of relevant data.

According to York and Bamberger (2020), apart from humanitarian operations, BDA has influenced the growth and functioning of companies. It has increased interconnectedness and

created the idea of diversity in data. With the global development sector, it is important to be aware of data science and its development in society. This can be useful for the comprehension and adaptation of big data around the world. Humanitarian operations have witnessed an improvement and various changes that are significant for the development of business. Maximum primary industries have utilized big data to reduce environmental impact and boost a country's competitive advantage. The opportunity of the availability and administration of big data is offered to developing countries to increase viability within organizations and improve humanitarian operations. Most developing countries have applied big data for sustained and competitive operational resources in management.

5.4 Theme 4: Big Data Challenges Faced by Humanitarian Organizations and Solutions

Big data presents an astonishing amount of information that is created daily and should be refined with use. Many large companies and businesses tools to increase performance and continue refining data. Humanitarian organizations also take full advantage and create opportunity with analytical tools to refine and manage their data in real time. However, over time, certain challenges and issues have been observed while working with big data.

As Guay (2016) has mentioned, challenges arise from harnessing big data produced by social media, unmanned aerial vehicles (UAVs), mobile technologies, commercial remote sensing for humanitarian response, and disaster management. With new humanitarian technologies, business methods set the bar for actionable intelligence for emergent issues, such as natural disasters, atrocities, and pandemics. However, the sector lacks the essential structure and protocols to use these tools and techniques precisely, suitably, and securely. Humanitarian organizations face certain challenges in leveraging new technologies and using big data, including privacy, security,

and ethical challenges. Humanitarian organizations use all types of essential data, which provide information about the people affected by catastrophes (Guay, 2016).

However, data breaches or problems with the privacy and security of data are possible. Additionally, the exposure of personal data can also occur when an organization amasses a large quantity of data, which may also lead to ethical issues. Indeed, a major gap in mobile survey tools is the lack of minimal standards and professional ethics to guide the application of new information and communications technologies (ICTs) for humanitarian action (Raymond & Card, 2015). Data collection in the humanitarian sector has largely been driven by pilot projects or organically generated collaborations and initiatives that emerge when new capacities and tools can meet contextual demands. However, it is difficult to wrestle with questions of privacy when lives are at stake, or to take the time necessary to consider the security implications of releasing real-time data to the public when vulnerable communities can and should be warned (Guay, 2016). Another challenge concerns capacity and accountability in terms of the use of data in humanitarian operations. According to Sandvik et al. (2014), non-traditional data collection teams may be less equipped than traditional humanitarian actors to face the ethical, privacy, and security issues surrounding their activities, and they may not be familiar with or care about neutrality, impartiality, and accountability, which are key core humanitarian principles.

Humanitarian organizations have faced many issues with big data. In some cases, big data related to humanitarian responses has involved data bias, discrimination, false data, and threats to privacy (Meier, 2015). The participant organization controls the micro-working open-end data (a series of outsourced and decentralized small tasks many people complete over the internet and that together comprise a large, unified project without boundaries) and social media platforms, which can offer well-timed economic data compilation and analysis. However, this necessitates guidance

and the professionalization of traditional humanitarian organizations to attain precise and dependable outcomes.

Humanitarian organizations mainly use big data to aid in responding to natural disasters and other crises. Big data analytics is a field that merges computer science, signal processing, statistics, data mining, and machine learning, all of which help humanitarian organizations analyze their data (Qadir et al., 2016). However, even with such a large impact and efficient work, some issues remain, such as too much or unnecessary information. For information to be a resource, it must be aligned with and targeted to a task (Guay 2016). During a disaster, uncontrolled information can be confusing and misleading. There has been an increase in the variety, volume, and velocity of data and the operational framework of humanitarian work, which makes decision-making particularly difficult. Additionally, information biases can emerge. Increasing the readability, searchability, and timeliness of information cannot address the problem of political positioning that often emerges during dialogue and that remains a barrier to the use of information for multi-organizational, multi-level, and multi-disciplinary collaboration between and among digital and traditional communities.

Another issue that may occur in the application of big data is coordination and collective action problems. Remote management in high-risk crisis situations is now possible due to advancements in ICTs, even in traditionally low-resource settings. Such an approach offers new opportunities for multi-modal governance in areas of limited statehood (Livingston & Guay, 2015). However, this practice also raises questions about distancing tendencies, as on-the-ground presence gives way to new digital proximities, contributing to a re-allocation of risk away from the humanitarian organization and toward local communities, as well as leading to an overestimation of the degree of beneficiary empowerment and participation through ICTs (Sandvik

et al., 2014). Facilitating shifting roles and new relations may require new rules for data governance to standardize information management procedures, integrate data collection systems, and encourage the right amount of competition in an environment that is traditionally characterized by the duplication of efforts, siloed approaches, and competition between players.

The standardization and integration of divergent, interoperable data streams is another area where issues may arise. In the networked age, the scarcity of information is no longer a concern; the opposite is true (Harvard Humanitarian Initiative, 2013). Organizations need to determine how to make sense of too much data made accessible by mobile technologies, social media, and access to visual information through more affordable, commercial, remote sensing technologies and UAVs. Such work requires establishing mechanisms to limit information, clean and filter data generated through divergent sources, and share that information horizontally and in near-real time. Matters of sovereignty, legitimacy, participation, and relationships are challenges humanitarian organizations may encounter while using big data for their operations. With technology and big data in humanitarian action, the assumption that ICTs are unequivocally empowering or level the playing field complicates legitimacy and power inequities (Meier, 2011). While technology actively generates new roles, resource distribution, rules, relationships, and vulnerabilities in the humanitarian space, it is possible that these effects are not inherently democratizing. At a minimum, humanitarian organizations must make sure that their use of big data and ICTs neither formalizes current power inequities nor exacerbates them. At best, and through a critical lens, they should harness technology and share granular, real-time data in a way that empowers local and vulnerable communities to be resilient in the face of adversity, danger, or catastrophe (Meier, 2011).

Big data has greatly changed the information technology sector. For example, it has changed organizations' database management, allowing it to work more efficiently (Shah et al., 2019). However, many problems and challenges have been identified with this digital tool. Nevertheless, the upcoming challenges can be resolved by adopting some of the most effective and applicable solutions in the big data field (Chesterman et al., 2017). The analysis of big data can be difficult using traditional data analytics, because of this, big data might lose its effectiveness due to the five V features: high velocity, low veracity, high volume, high variety, and high value. However, to make big data effective, several digital tools such as artificial intelligence (AI), machine learning (ML), and computational intelligence (CI) are used as BDA solutions (Gasser et al., 2020). These solutions can make processing faster, more accurate, and more exact to address the enormous volume of data.

The major issue which has been addressed here is that big data cannot process one large data in real time. Therefore, it is necessary to find an effective solution that can be implemented to mitigate big data issues in humanitarian operations, as they will benefit from using big data. The opportunities big data presents are growing; therefore, it is necessary to address this issue. One of the most essential and acceptable solutions in humanitarian operations is using advanced data analysis techniques (Qadir, 2016). This technique consists of ML, NLP, CI, and data mining. These other digital analysis tools can be used with big data to process data easily and smoothly. These techniques aid in the creation of potential strategies such as parallelization, incremental learning, divide and conquer, sampling, feature section, granular computing, and instance selection.

These advanced techniques assist in converting major problems related to data into smaller ones to improve decision-making. Additionally, they also reduce cost and are more efficient in

processing. The only problem with working with big data is refining a large amount of data at a time. Parallelization can decrease calculation time by dividing large problems into smaller cases and performing the smaller tasks concurrently (Schadt et al., 2010). Humanitarian operations include large amount of data, and sometimes, there are data that cannot be segregated; this leads to inaccurate results. Dividing the large data into smaller pieces helps determine whether the data provided is accurate and requires less time to analyze.

Humanitarian operations can also opt for a divide and conquer policy, which plays a significant role in big data processing (Ali et al., 2016). This approach has three crucial steps. The first is to reduce one large challenge into many small issues and then solve the smaller problems. Solving the smaller issues contributes to solving the large problem, as they are interrelated. Lastly, the solutions to the smaller problems can be integrated into one large solution.

5.5 Summary

The secondary research provided an understanding of the role of big data and the implications of data and science, which are vital for the operations of humanitarian aid in developing countries. It gave an understanding of the role of big data operations and analytics, which are a part of this research. The thesis used updated articles and journals, which are important to clarify the role of data science in research. Organizations and business communities have utilized BDA and operations that produce structured and semi-structured data to transmit information. Various projects apply BDA and are useful for functioning and meeting the requirements in different business areas. Secondary research has played a prominent role in the critical analysis of the facts related to the data process.

The subject of data science has gained traction, and BDA can provide answers to some previously unanswered strategic and tactical concerns (Ji-fan Ren et al., 2017). The most significant advancement in humanitarian supply chain management is the analysis of unstructured data. The amount of unstructured data produced during a crisis is enormous, and it all appears within a short period of time. Social media is one source of unstructured data. Humanitarian aid efforts can benefit from the sentiment analysis of this unstructured data. Furthermore, cognitive systems, such as IBM's Watson, have demonstrated that machine-machine interaction to analyze massive datasets will be a reality in the near future (Chen et al., 2016). Until then, man-machine interaction is widely used to better analyze unstructured data. Trained manpower in the field of big data in humanitarian supply chain management will help overcome the field's limits.

The thesis findings suggest that big data usage should be improved, as it is beneficial. The use of big data can be improved by reasonable resource dependence adaptation by organizations and countries to help improve humanitarian services. One major lesson from RDT is that companies that lack the resources needed to achieve their objectives are more inclined to form relationships with others in order to obtain those resources. Customer and supplier connections are crucial linkages for organizations to reduce the unpredictability in their operational environment (Cao & Zhang, 2010). According to RDT, member firms in a supply chain should be dependent on one another and collaborate to achieve higher long-term performance improvements rather than chasing short-term advantages at the expense of others. Firms depend on resources others provide in order to sustain growth, and they depend on other organizations that may depend on them (Pfeffer and Salancik, 2015). One important assumption of the RDT is that firms cannot be fully self-sufficient with regards to strategically critical resources for survival. They need to depend on

resources from outside parties to compete (Heide, 1994) and carefully manage this dependency with other firms to strive for sustainable development (Ulrich & Barney, 1984).

Additionally, these companies' roles extend far beyond delivering profits to their shareholders; they must address social issues such as participation in disaster and humanitarian operations. Stakeholder theory claims that businesses create externalities that influence many people (stakeholders) both inside and outside the company. Stakeholders frequently increase pressure on corporations to lessen negative impacts and increase favorable ones. Various categorizations have been used to group stakeholders, including direct, indirect, primary, and secondary, or based on multiple dimensions of legitimacy (Delmas & Toffel, 2004). Despite many developments with ST, the basic premise is that internal and external groups influence organizational practices. Environmental externalities may be internalized through these stakeholder pressures within and between supply chain members. The humanitarian supply chain contains many stakeholders, even more than individual businesses, and these stakeholder groups are growing, especially in relation to environmental issues (De Brito et al., 2008). Hence, the application of this theory by humanitarian organizations can lead to stakeholders putting pressure on a firm to increase its beneficial social impact. Morals and values are critical in reducing the likelihood of undesirable consequences or misconduct. The enthusiastic support and pressure from stakeholders can lead to an organization's supply chain being improved for a more beneficial environmental impact.

6.0 Chapter Six: Conclusion and Recommendations

The aim of this study was to investigate how big data is used in humanitarian operations in developing countries. Chapter one outlined the current understanding of the topic, the aims, objectives, research questions, and rationale. Chapter two discussed the background of the concept of big data and humanitarian operations. In addition, the historical developments in the literature that led to the current research topic were outlined concisely, followed by a review of the literature on the topic. Secondary sources such as academic journals and NGO publications were utilized. The researcher identified the opinions and arguments of other key researchers on big data and humanitarian operations in developing countries, and this analysis led to the selection of journal articles to include for further analysis in chapter 3. The literature review also helped understand relevant theories employed in the thesis (RDT and ST).

In chapter 4, to answer the research questions, secondary data was gathered. The researcher determined that a qualitative approach was most suitable. In this section, an in-depth explanation of the overall research method for the study and each technique was provided. This chapter also highlighted the limitations of the thesis. The researcher then presented the results of the secondary research in chapter 5, which extensively analyzed and discussed these results considering the existing literature to determine whether there were any contrasting or similar areas. There was an in-depth discussion on the evidence gathered from the literature review that was organized using themes. In this chapter, in relation to the aim of the study and its overall objectives, the results were outlined. The chapter also provided relevant recommendations so that adjustments can be made in future research and for humanitarian organizations and governments that use or intend to adopt big data in their operations. The future implications of the topic are also addressed in this chapter.

6.1 Conclusion

This study explored the role of big data in humanitarian operations within developing countries. Humanitarian operations usually involve activities related to safety and wellbeing. This study found that humanitarian organizations must work with a large volume of information to complete their work successfully. To do so, they face significant challenges in collecting, managing, interpreting, and storing these data securely. However, the innovation in information technology has provided the opportunity to manage a large volume of data through BDA tools, enabling organizations to collect, manage, and store data successfully while reducing the risks to data safety. This current study included a thorough secondary qualitative method to answer the research questions and meet the research objectives. The findings successfully met the research objectives. For instance, they revealed that BDA is considered a critical success factor for humanitarian operations due to its capacity to build a large dataset and manage those data effectively during emergencies.

The findings also highlighted different tools and procedures used for BDA in different humanitarian operations, especially in NGOs. The study showed that BDA plays a vital role in the supply chain network of humanitarian operations in the development sector and developing countries. However, some areas require improvement. In developing nations such as India, resources such as data scientists are lacking, which is a key challenge in utilizing BDA to its full potential. Organizations working with community projects, some of which have been discussed in this study, use BDA in their logistics to improve demand-supply balance. These organizations, including NGOs, work with a large amount of data in education, healthcare, women and children's safety, and other fields. Throughout the year, these organizations must gather and analyze large amounts of data, including many personal details of the citizen involved in such projects. The

organizations use BDA to improve outcomes, resilience, and sustainability by ensuring data safety and easy sorting by using big data tools.

This study also found that big data is used extensively in disaster management. Big data enables NGOs and other organizations associated with disaster relief to locate and recognize disaster-prone areas and citizens' needs during an emergency by collecting a large volume of data from direct witnesses and a diverse range of sources, including social media. Furthermore, other procedures, including data mining, interactive platforms, and mapping software, play a crucial role in remote interaction, information collection, and helping reach relief funds.

The research also concluded that there are five key data attributes of big data in humanitarian operations: volume, variety, veracity, value, and velocity. Organizations are learning to deal with these attributes of big data in their projects to achieve higher resilience and sustainable outcomes. However, the research also found these attributes present some challenges related to BDA in different humanitarian operations. Therefore, overall, it can be concluded that in developing countries, humanitarian operations gain significant benefits from using big data. The industry should improve its usage by mitigating challenges and recruiting more data scientists and experts to improve outcomes. Considering the importance of stakeholders, the role of these companies goes far beyond the delivery of profits to their shareholders; they must address social issues, such as engagement in disaster and humanitarian operations.

Future researchers should be aware of the research's limits, as various practical issues may arise, such as during the searching, screening, and synthesizing stages. Furthermore, systematic reviews necessitate access to a variety of databases and peer-reviewed publications, which can be difficult and costly for non-academic researchers. Furthermore, because the study was done during the peak of the Covid-19 pandemic and budget constraints, the researcher chose not to travel to

conduct interviews in developing countries but rather opted for secondary data collection. The author used a clear, rigorous methodology for the review technique; yet the process took longer than intended. It might be less time consuming for future researchers to replicate the review procedure if a team handled it, and different researchers might be participating in data collection.

6.2 Recommendations

Big data has achieved enormous popularity because of its effectiveness and its major five elements: volume, value, velocity, variety, and veracity. However, certain issues related with big data persist in its use in humanitarian organizations. Therefore, humanitarian organizations can implement certain recommendations to avoid those issues and utilize big data effectively to maximize the organization's value (Jamiy et al., 2015).

Various large businesses have accepted that big data is an outstanding opportunity to attain consumer insights, supervise business functions, and anticipate business results. All organizations that use data must how to maximize their use of BDA. First, they must create a big data strategy that focuses on extracting business value. The organization can use big data for deep investigations related to advanced analytics. Additionally, a big data strategy can also support a business approach and improve growth and development.

It is important for organizations to use a technology roadmap to shift from existing data platforms to new ones. Organizations should use a big data technique as a guide to create an effective approach to deal with existing data and then consider the new data in the given platform. This will help refine existing data first and keep it separate from new data. Moreover, it will be an effective use of time and thus be cost effective and less time consuming. In addition, creating a technological strategy to enable a big data strategy is an effective approach. With the help of a

technological strategy, an organization can create one roadmap for every type of data, such as structured, unstructured, and semi-structured data formats. These strategies help capture, categorize, store, and process data. This will further help organizations prepare for future emergencies.

In addition, a common observation is that organizations lack trained staff and personnel. Hiring talented staff for big data work is important. Often, organizations utilize big data for their work but do not have talented or trained staff. This leads to time-consuming and undesirable outcomes, as those available lack the skills to perform the necessary analytical work. Therefore, organizations should review their hiring procedures to hire the best person for the job. However, doing so could increase the company's costs, as big data analysts charge more for their work. Consequently, it may be advisable for humanitarian organizations to conduct skill development programs for interested employees, which would be relatively inexpensive. In short, it is important for companies to employ the appropriate people or train existing employees to a satisfactory level, as failing to do so could result in the delayed delivery of projects, or worse, failed projects.

Governance is another crucial aspect that organizations should examine. Creating an effective governance model helps with data completeness, integrity, and quality. In addition, humanitarian organizations should not focus on volume but on value, which should be extracted from the data using BDA. The problem arises when the data piles up, creating a large volume of data to be analyzed, which can sometimes be difficult and lead to poor outcomes. It is obvious that data analysis provides value to organizations, especially humanitarian ones. The operations of humanitarian organizations highly depend on the extraction of data. Therefore, it is necessary for them to investigate the processing of the data, which should be extracted and add value.

Furthermore, the firm should protect the computation code used in their big data projects. Data breaches and theft are prevalent in today's world, even among huge corporations. As mentioned in the study of Bhandari et al. (2016), implementing comprehensive input validation and filtering in the analysis can prevent security threats related to BDA. This can be done by building up algorithms that validate the input of large set of data.

According to the study of Benjelloun and Lahcen (2019), the anonymization of confidential or personal data is important. It is a recognized method for data privacy and protection, and humanitarian organizations should use it to prevent data breaches. Such organizations can implement effective, useful solutions using big data to safeguard their data.

6.3 Future Scope of Research

This study contributes to knowledge by examining how adopting big data in humanitarian operations can ensure efficiency and cost effectiveness and enhance the potential to save more lives in desperate situations. In addition, future researchers can use this study as part of an ongoing body of research on the role of big data in humanitarian operations. Donor agencies and focal NGOs can use the prescriptive findings can to design interventions and collect the necessary data to facilitate superior humanitarian outcomes.

The researcher also identified two organizational theories for future research: institutional theory and social network theory (SNT). The study of institutional theory focuses on how an organization responds to external control (Liang et al., 2007). Because each government has its own procedures for the humanitarian supply chains, external pressure varies by country. Future studies can show how these external forces differ from one country to the next. One organization's

use of big data to organize humanitarian supply chain management methods may encourage others to do so, as well. It is worth considering how this would affect total emergency response.

Social network theory (SNT) emphasizes how individuals, groups of people, and organizations interact with each other within their network (Wu et al., 2012). During disaster relief operations, social networking websites play a vital role. During humanitarian efforts, the volume of data created by social networking platforms spikes dramatically. This information can be utilized to put social network theory to the test. It would be interesting to compare the collaboration of multi-national social media firms that help disaster survivors reconnect with their relatives with NGOs or humanitarian organizations to deliver goods and services more efficiently during relief operations. Understanding the information concealed in vast volumes of unstructured data will be required for such a joint effort.

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