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STRENGTHENING HUMANITARIAN DISASTER RESPONSE VALUE CHAIN USING ROBOTIC PROCESS AUTOMATION: A CASE FOR WORLD FOOD PROGRAMME

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A research project report submitted in partial fulfillment of the requirements for the award of Master of Science Degree in Information Technology Management of the University of Nairobi

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Declaration

This research project report is my original work and to the best of my knowledge has not been submitted for any other award in any University.

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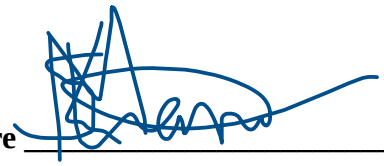
Signature  **Date**_____**21-05-2022**_____

This research project report has been submitted for examination in partial fulfilment of the requirements for the Master of Science in Information Technology Management of the University of Nairobi with my approval as the university supervisor.

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Abstract

In the digital space, Robotic Process Automation (RPA) is drawing more attention in the corporate world. The advent of RPA has the potential to disrupt the traditional Humanitarian Disaster Response Value Chain (HDRVC). The gaps unmasked by the analysis of the HDRVC make coordinating the organizational activities and finding the right resources to combat the catastrophes difficult as it requires time and money, which neither the humanitarian agencies nor the victims have during a disaster. The objective of this project was to analyze the HDRVC and establish opportunities within which RPA can be applied to bring efficiency and effectiveness in the value chain system. The project used Porter's Value Chain Framework to analyze the HDRVC and sought to validate the framework as suitable for HDRVC analysis. The project used a descriptive case study of World Food Programme to understand the opportunities in which RPA can be applied. Results showed gaps in the HDRVC which create the best opportunity to apply RPA in ensuring fast, efficient, and cost-effective aid delivery to the beneficiaries. Further results using the Confirmatory Factor Analysis (CFA) in Structural Equation Modeling (SEM) to test and validate Porter's value chain framework as suitable for HDRVC indicate that PVCM is reasonably near a perfect fit. Consequently, PVCF was found suitable for HDRVC. These results can be used by different other humanitarian organizations to tailor their value chain to assume seamless, effective, and efficient aid delivery. The results provide a concrete tool that can be used by different organizations, regardless of the industry, to analyses their value chain system in quest for effective service delivery. This research project envisages the future of the humanitarian sector by introducing RPA and describing its usage in revolutionizing the HDRVC by creating a seamless, effective, and efficient aid delivery system. Despite the overwhelmingly positive results, we acknowledge that qualitative study methods do not guarantee validity and reliability. As such, considerations for RPA-based aid delivery operations and a series of research questions are presented with the objective to create a dialogue in this evolutionary area. Ultimately, to remain relevant, organizations must combine innovative technologies with the skills and knowledge of qualified professionals.

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Abbreviations

BPMS - Business Process Management System

CFA - Confirmatory Factor Analysis

HDRVC - Humanitarian Disaster Response Value Chain

HLP - High-Level Panel of the United Nations Secretary-General on Humanitarian Financing

PVCM – Porter's Value Chain Model

RPA – Robotic Process Automation

SEM - Structural Equation Modeling

IA – Artificial Intelligence

ML – Machine Learning

UNWFP – United Nations World Food Programme

GOF- Goodness-of-fit

TLI – Tucker Lewis Index

CFI – Comparative Fit Index

RMSEA – Root Mean Square Error Approximation

GFI - good-of-fit index

Definition of Key Terms

Automation - This is a term used for technology applications in processes to minimize human involvement in their execution

Humanitarian Disaster Response - It is the process through which international humanitarian organizations such as the United Nations and other Non-Governmental Organizations deliver aid to the affected communities during a catastrophe.

Robot - It is a software embodied artificially intelligent agent that can perceive its surroundings, executing computations to make decisions, and acting in the real world in ways that humans would normally do.

Robotic Process Automation It is a software-based methodology for automating processes via the use of technology that is guided by business logic and structured inputs.

Robotics - An interdisciplinary subject that combines computer science and engineering, robotics is concerned with the design, building, operation, and usage of robots.

Value Chain - A value chain is a collection of actions carried out by a company to generate value for its consumers.

CHAPTER 1: INTRODUCTION

1.1. Background

Robotic Process Automation (RPA) is a technology that mimics human workers to complete specified jobs quickly and efficiently (Fung, 2014; Lacity et al., 2015). Business logic and structured inputs guide this software approach to automating activities (Lacity et al., 2015). RPA, powered by AI, has emerged as a prominent digitalization area. AI-driven robots and technologies will unlock human productivity in the next few years (Beerbaum, 2021; Körner, 2018; Heymann & Schattenberg, 2017; Kerremans, 2018).

As exemplified by the UN's 2030 Agenda, robotics, automation, and AI can solve many societal concerns. They can improve process performance, efficiency, scalability, accountability, security, and process compliance concequently increasing standard of living and improving the quality of life in developed and developing countries respectively (Madhavan, 2019). It is simple to implement and relatively inexpensive compared to traditional process automation, with the ability to execute tasks autonomously uninterruptedly, quickly, flawlessly, and traceably (Asatiani & Penttinen, 2016; Fung, 2014; Lacity et al., 2015; Lacity et al., 2017). The use of hardware robots has been extensively applied in humanitarian contexts for a substantial period (van Wynsberghe & Comes, 2019). However, despite the importance of software robots and RPA in humanitarian operations, their study and application have been overlooked.

A compelling HDRVC stream should drive the need to improve the population's quality of life affected by disasters. Madhavan et al. (2015) explain how researchers, practitioners, humanitarian relief workers, responders, field analysts, and humanitarian aid agencies can exploit Robotics and Automation to alleviate human suffering. Like any other organization, humanitarian organizations' value chain is embedded in a more significant stream that Porter calls the value system. Disasters call for the humanitarian value system's players to collaborate. Consequently, the humanitarian organizations' value system comprises the governments, the military, civic society, and humanitarian groups that find answers that can alleviate the pain of the affected communities in a disaster. The efficient and scalable execution of non-value(cost) activities and the reduction in turnaround times represent an excellent opportunity to use RPA in humanitarian disaster relief (Hofmann et al., 2020; Sutherland, 2013). Value creation in this regard would be through an efficient and compelling Humanitarian Disaster Response Value Chain (HDRVC) geared towards

fast, timely, and cost-effective responses to disasters. After all, Porter insists on a firm's capacity to innovate and upgrade as essential factors leading to its ability to compete in the industry (Porter, 2008). It is crucial to emphasize the value chain in the humanitarian sector as it defines how much an organization can respond to an inevitable catastrophe.

Catastrophic uncertainty in terms of location, time, and severity brings a challenge in pre and post-disaster response due to the insufficient supporting processes and resources, including; financial, human, technical, and informational, all of which can delay the reaction time in humanitarian organizations (Modgil et al., 2020; Balcik et al., 2010). Additionally, the relief workforce frequently includes short-term volunteers or temporary workers, neither of whom may have the necessary experience to coordinate activities during a disaster relief effort (Modgil, Singh, and Foropon, 2020; Balcik et al., 2010; Pushpa Kumar & Asta Lakshmi, 2015). Planning and executing these activities and finding the right resources to combat the catastrophes requires time and money, which neither the humanitarian agencies nor the victims have during a disaster (HLP, 2016; Balcik et al., 2010; Modgil et al.,2020).

To create and sustain superior performance in service delivery during a crisis, humanitarian organizations must adopt an efficient and effective HDRVC. Analysing the value chain processes of the United Nations World Food Programme will provide insights into the gaps, challenges and an opportunity within which RPA can be utilized to improve humanitarian efforts' efficiency (saving time) and productivity (saving costs) (Madhavan et al., 2015; Asatiani & Penttinen, 2016; Lacity et al., 2015). With RPA, humanitarian organizations will have an increased competitive advantage which will create a virtuous circle by attracting more funding and participants in humanitarian crisis response and, in turn, bridge the funding gap (HLP, 2016; Balcik et al., 2010). Furthermore, an efficient and effective value chain leads to fast aid delivery because employees will focus on the more value-adding activities involving personal interaction, problem-solving, and decision-making (Syed et al.,2020). Therefore, no one would have to die or live-in deplorable conditions due to a lack of funds or slow response by the aid providers. It would be a significant win for humanity at a crucial time.

1.2. Problem Statement

Uncertainty in terms of location, time, and severity complicates pre- and post-disaster response. The insufficient supporting activities and resources (financial, human, technological, and

informational) affect the performance of the value chain system and worsen the situation leading to delayed aid delivery (Balcik et al., 2010; Modgil et al., 2020; Pushpa Kumar & Asta Lakshmi, 2015; Porter, 1985). Often, humanitarian organizations combat this by outsourcing some of the services at every disaster occurrence (Balcik et al., 2010; Modgil et al., 2020). As a result, there is a creation of rule-based, tedious, repetitive, and prolonged processes yet crucial in delivering aid to the beneficiaries. Consequently, coordinating these support activities and finding the right resources to combat the catastrophes requires time and money, which neither the humanitarian agencies nor the victims have during a disaster (Balcik et al., 2010; HLP, 2016).

Hardware robots have been used to automate primary value chain tasks in the humanitarian sector, whereas software robots have been used less for secondary operations. Porter (2008) emphasizes the necessity of simplifying secondary operations since delays or malfunctions in one value chain activity affect the cost or performance of others. Analyzing the HDRVC will expose gaps, opportunities and challenges within which RPA can be leveraged to ensure cost-effective and timely disaster response.

1.3. Objectives

1. To analyze the World Food Programme Disaster Response Value Chain
2. To evaluate how Robotics Process Automation can create efficiency within the Humanitarian Disaster Response Value Chain.
3. To evaluate the potential of implementing Robotics Process Automation in the Humanitarian Disaster Response Value Chain.
4. To validate the Porter's Value Chain framework as suitable for Humanitarian Disaster Response Value Chain.

1.4. Research Questions

1. What are humanitarian value chain's technical gaps?
2. What is the potential of implementing RPA in the HDRVC?
3. How can RPA create efficiency in the humanitarian value chain?
4. What are the effects of an effective and practical value chain in HDR?

5. What is the cause of an ineffective value chain in the HDR sector?
6. What are some of the existing value chain frameworks?
7. What are some of the existing framework validation methods?

1.5. Significance of the Study

The validated framework will provide guidance to humanitarian organizations, public sector organizations, and NGOs on technology adoption for an efficient and effective HDRVC. For humanitarian organizations and NGOs, the research enhanced the existing body of knowledge on software automation for disaster response. Significant effort has been dedicated to the automation of the primary value chain activities in the humanitarian sector using hardware robots, but less has been done in exploiting the software robots for the secondary activities of the HDRVC. Many researchers have emphasized the need to use automation in alleviating the suffering of the affected communities (Madhavan et al., 2015). RPA can tackle conventional and emerging humanitarian concerns.

This project, which provides an overview of the benefits of the integration of RPA into the humanitarian disaster response, will be a guiding reference to the organizations seeking to improve the quality of their HDRVC. The project will educate and convey to humanitarian organizations, non-governmental organizations, and wider public sector organizations how the use of RPA may enhance productivity, operations, and service delivery.

The project will bring together universities, technology companies, NGOs and other humanitarian organizations in conducting more research and realizing the right skills and capabilities in the industry. Effectively, there is an expected skyrocket of IT enabled professionals which will be a significant milestone towards the right skills in any field.

1.6. Assumptions

That the respondents shall agree to participate in the study with total honesty and without fear of any possible repercussions.

1.7. Limitations

Using qualitative study methods means validity and reliability of data collected is not guaranteed. Moreover, replicating a study with qualitative research is extremely difficult as it occurs in natural settings.

The Survey method used in data collection does not always guarantee the correct picture of events.

CHAPTER 2: LITERATURE REVIEW

2.1.The World Food Programme (WFP)

WFP is the world's largest humanitarian agency, saving lives in disasters and delivering food aid. Their objective is to help communities and people recover from natural and man-made disasters. WFP provided direct assistance to a record number of 115.5 million clients in 84 countries through in-kind food distribution and cash-based transfers, over 20% higher than in 2019. (World Food Programme, 2021). On any day, there are 5.6k trucks with 100 aircraft and 30 ships on the move enabling timely disaster response to the affected. The 2020 WFP Annual Report presents 15 million as the number of children that WFP reached out to. Initiative to iterate innovation into the aspects of Supply and Value Chain to ensure cost effectiveness and timely response to disasters (World Food Programme, 2021).

Covid-19 unleashed the worst global health emergency of the past century, forcing organizations and especially WFP to scale up disaster response and provide its offices with surge capacity to ensure the continuity of existing humanitarian operations and increased support for national safety net systems (World Food Programme, 2021). WFP increased its common services to convey supplies and personnel to pandemic frontlines. WFP Strategic Plan (2022–2026) calls for automating WFP's operations to help staff make better judgments and simplify their work. WFP's process automation will improve employee services and partner digital skills (WFP, 2022–2026).

WFP Supply Chain Annual Report for 2019-2021 provides critical parts of its supply chain system, including planning to increase WFP's response efficiency. Business Support is another crucial core support element that helps WFP operate and execute its objectives. According to the annual report, WFP has responded to more emergencies each year over the past decade, necessitating automation. According to the 2020 Supply Chain Annual Report, WFP uses innovative technologies to monitor and ensure quick response to emergencies.

WFP's Policy on Disaster Risk Reduction and Management states that timely resources and technical assistance are crucial to program effectiveness. Stronger relationships with specialized groups can improve WFP's infrastructure development and engineering programs.

WPF insists on simple, user-friendly administrative processes to extract maximum value from its technology muscle, as evidenced in the DIGITAL TRANSFORMATION Beyond the Annual Performance Report 2019 series. The research highlighted automating time-consuming operations that restrict workers from performing more sophisticated duties.

According to the WFP Management Plan (2020–2022), a financial imbalance of USD 3.1 billion (29%) in 2020 will impair WFP's ability to help affected people. The financial imbalance will lead to 35-50% cuts in development-focused programs, missing opportunities to lessen and prevent future humanitarian needs. WFP must use its resources effectively to address immediate humanitarian challenges including violence and climate change, while also emphasizing the need for long-term solutions that create resilient livelihoods and contribute to peace. Process and form automation simplify and streamline fundamental functional procedures. The $11.0 million planned for automating core business processes has allowed WFP to automate repetitive work and streamline time-consuming processes to improve operations and free up staff time. WFP must keep extending and sustaining these platforms and services, integrating data from more operations and divisions, and automating and simplifying procedures.

WFP prioritizes IT-enabled efforts to improve operations and support services. WFP will automate and streamline manual business procedures to save costs, increase productivity, and improve performance reliability. The Finance and Treasury Division is trying to digitize and automate tiresome operations to free up finance experts for higher-value tasks. Opportunities include automating cash replenishment forms, national reports, and UN donor reports. Robotic process automation is needed by 2020 to reduce or eliminate manual data entry.

2.2.Humanitarian Logistics

Humanitarian Logistics plays a vital role in humanitarian disaster response (Pushpa Kumar & Asta Lakshmi (2015). These logistics systems are crucial in procuring, storing, and transporting supplies and resources, necessary machinery and equipment, and any casualties pre, during, and post-disaster periods (Pushpa Kumar & Asta Lakshmi, 2015).

Back-office duties support humanitarian logistics. These include IT, HR, business infrastructure supply chain management, accounting and finance, and catastrophe preparedness (da Costa et al., 2012). These indirect tasks are vital in the final disaster response, according to da Costa et al.,

2012. They integrate decision-maker information with beneficiary services as part of the humanitarian value chain. These tasks are rule-based, require little or no cognitive decision-making, are boring, repetitive, and low-complexity, making them perfect for automation (da Costa et al., 2012; Lacity et al., 2015). RPA can save time and resources, enhancing profits. Cost-savings vs. outsourcing. RPA deployment would relocate workers to the most influential value chain operations, creating efficiency and beneficiary satisfaction. RPA minimizes or eliminates service support centers. RPA decreases costs and improves efficiency, analytics, performance, and quality.

2.3.Humanitarian Disaster Response Value Chain

Natural disasters and complex emergencies cause humanitarian crises. The UN and other NGOs respond to crises by sending food, water, sanitation supplies, medicine, and medical equipment (Hamedi et al., 2012). Humanitarian Disaster Response (HDR) transfers relief from providers to disaster victims. HDR needs time to be effective. (2012). Humanitarian Disaster Response Value Chain describes the activities international humanitarian organizations like the UN and NGOs conduct to aid crisis-affected communities (HDRVC). The HDRVC incorporates disaster management. Behl & Dutta (2019) recognized the important topics in humanitarian supply chain management: humanitarian logistics, value chain, theory-focused research, case studies, mathematical models, and big data analytics. The humanitarian value chain includes infrastructure, technology, HR, finance, and procurement. da Costa et al. (2012) cite value efficiency as a key aspect in supply chain flow. Value stream combines decision-maker information with beneficiary products (Oguta, 2016). Value chain synchronization in humanitarian logistics is key to speedy, on-time catastrophe response and organizational effectiveness (Salem et al., 2018). The value chain is critical to the success of disaster response activities, thus it's important to prepare ahead to ensure a quick and effective response. RPA promises cost-effectiveness, efficiency, and availability.

Humanitarian catastrophe management focuses on aiding affected communities. Porter (2008) notes that delays or malfunctions of a value chain activity affect the cost or performance of others, therefore secondary activities need similar attention to provide cost-effective and timely disaster response. This is done by analyzing a company's quality and progressive value chain. Organizations must, among other things, understand the current state of the entire chain, map the

current state of their value chain, identify bottlenecks and opportunities, and establish a future state vision that involves mapping the future chain and developing an action plan to a future goal.

Parties involved in the humanitarian value system face different challenges to delivering lifesaving aid. Varied interests, scarce resources due to the inefficient value chain, and organizational structures within agencies impede the effectiveness of efforts to the victims (Weiss and Collins, 2018). Due to rising demand, the humanitarian financing deficit has strained existing resources (Salem, et al., 2018). The existence of NGOs and their operations is clear, and a delayed response to disasters could cause social-political and ethical instability. There is a need to streamline the value chain operations by adopting strategies that improve how aid is delivered to the beneficiaries. For instance, giving equal attention to indirect yet crucial services such as information systems, technology, human resources, firm infrastructure supply chain management, finance, and disaster preparedness (da Costa et al.,2012). To achieve a basis for differentiation and a relative cost position, humanitarian organizations must focus on the value chain of the many discrete activities required to enable the supply chain and logistics in disaster response.

Empirical evidence demonstrates obvious advantages of applying technology, especially robots, in value chain activities in reducing operational costs, improving value chain agility, and increasing beneficiary satisfaction. RPA offers an opportunity to support and improve humanitarian aid and its processes. RPA promises a new way for organizations to bring business intelligence, data analysis, and more effective forecasting in disaster management. It offers 24/7 availability while tackling traditional and novel challenges of the HDVRC activities. Consequently, effects on the way the beneficiaries receive aid are felt

2.4.Robotic Process Automation (RPA)

RPA accesses and executes human-like tasks or imitates systems (Lacity et al., 2015; Moffitt et al., 2018; Van der Aalst et al., 2018). Industrialization has expanded task automation to promote economic efficiency, save money, and improve product quality. High volumes of structured digital data are ideal for RPA automation. It's fixed or user-interface-driven. Rule-based and requires minimal cognitive decision-making. These operations are monotonous, repetitive, and simple (Aguirre and Rodriguez 2017; Asatiani & Penttinen 2016; Fung 2014; Lacity et al., 2015; Moffitt et al., 2018; Hofmann et al., 2020; Syed et al., 2020). Data archiving, format conversions, large-

scale data entry, periodic reporting with data analysis, transfer, validation, and bulk email production are RPA software strengths. Table 2.1 lists general RPA suitability criteria.

Table 2. 1 Criteria for Robotic Process Automation

The large number of transactions need to access numerous systems	The jobs under consideration for RPA are performed regularly or contain a large number of subtasks. The assignment requires access to different systems. Transferring data from a spreadsheet to a customer registry is one example of a task.
Low cognitive requirements Easy breakdown into unambiguous rules	The task does not require creativity, subjective judgment, or complex interpretation skills. The task is easy to break down into simple, straightforward, rule-based steps, with no space for ambiguity or misinterpretation.
Environment that is stable	The task is carried out within a predefined set of IT systems that stay consistent each time a task is carried out.
Proneness to human error	The task is prone to human-specific mistake, which computers do not experience. Example: matching numbers across multiple columns
Limited need for exception handling	The task is highly standardized, with little or no exceptions occurring while completing it
A clear understanding of the current manual costs	The company understands the current cost structure of a task and can estimate the difference in cost and calculate the return on investment (ROI) of RPA.

Source: Fung (2014), Lacity et al., 2015, Aguirre and Rodriguez (2017); Asatiani & Penttinen (2016)

RPA automates business processes using technology and business logic. It automates tasks across multiple technologies using software (Lacity et al., 2015). Companies can collect and interpret applications using software or a "robot" to execute transactions, update data, trigger reactions, and communicate with other digital systems. RPA's core application mimics human or system activities (Lacity et al., 2015; Moffitt et al., 2018; Van der Aalst et al., 2018). The rule-based application automates repetitive, long, dull tasks. The software is trained on complex, flexible, and adaptive data. RPA uses range from automating email responses to deploying hundreds of bots to automate ERP tasks. RPA automates monotonous, rule-based business procedures so people can focus on higher-value tasks. RPA is a doorway to intelligent automation (IA), which uses ML and AI to predict future outputs.

RPA improves business efficiency. It reduces time, cost, and physical chores and workload (Hofmann et al., 2020). RPA technology reduces HR-related expenses by 20%–50% and transaction processing costs by 30%–60%, depending on quantifiable indicators such as the number of FTE employees replaced by robots (Hofmann et al., 2020; Syed et al.,2020). Reduced manual chores and burden have boosted time efficiency, as shown by a 30% to 70% decline in process cycle time, task handling time, and waiting time (Hofmann et al., 2020; Syed et al.,2020). RPA works 24/7 to improve a company's productivity. RPA frees humans from boring tasks. Workers will prioritize value-added tasks including interpersonal contact, problem solving, and decision-making (Syed et al.,2020). Companies who employ RPA effectively receive high-quality service. Syed et al. (2020) indicate that frequent transactional errors are decreased, as are human errors. Error-free tasks are automated.

RPA is easier to deploy, manage, integrate, and maintain than corporate systems and other automation, and it has a simple interface (Syed et al., 2020). Hofmann et al. (2020) and Syed et al. (2020) highlight RPA's time savings. RPA decreases risk and improves compliance (Hofmann et al., 2020; Syed et al.,2020). RPA gives firms flexibility, scalability, and control, which boosts efficiency. Businesses can use process data to make decisions.

While RPA's benefits are evident, firms can't assume adopting technology would result in benefits. Benefits depend on an organization's readiness for RPA, the RPA technology used, and the development and implementation of an RPA solution. These attributes vary amongst businesses and organizations. RPA planning and implementation are crucial. Second, RPA's impact on the workforce must be identified and handled. An RPA socio-technical analysis is essential to strengthen IT/HR policy and develop successful change management activities. Contextual changes can cause RPA robots to make mistakes. The error may go unnoticed for a long time, causing catastrophe. Ethical and security concerns surround RPAs that resemble humans.

Before using RPA, firms follow numerous methods. While RPA is simple, it requires assessment, research, and preparation to create and deploy a robot effectively and convince skeptical consumers (Asatiani & Penttinen, 2016). Any organization implementing RPA must follow a step-by-step methodology (Asatiani & Penttinen, 2016). First, the consultants must hold an RPA workshop to assess the host organization's readiness. This includes identifying automatable organizational procedures.

Second, consultants observe employees doing process activities. Consultants will record and change process flow. Processes are divided down into rule-based tasks.

The third phase demands a business case detailing robot automation and how to use human resources for cost effectiveness and better productivity.

In the last phase, the host organization approves the business case and consultants supply software robots. This step creates process libraries. Process library is a robot instruction manual. It's like a flowchart with branching decisions (Asatiani & Penttinen, 2016). Figure 1 depicts RPA installation.

Figure 2. 1 Stages of RPA implementation in an organization

Source: Asatiani & Penttinen (2016)

2.5.Robotic Process Automation in HDRVC

The humanitarian value chain plays a crucial role in coordinating care between donors and recipients cost-effective, fast, and reliable. The value chain faces five key business problems in the organization, including cost control, process visibility, risk management, and rising consumer demands, among others (Kumar & Rajeev, 2016). Automating the value chain processes will significantly improve humanitarian efforts' efficiency (saving time) and productivity (saving costs) while also increasing risk control. It will create a virtuous circle by attracting more funding and participants in humanitarian crisis response and, in turn, bridge the funding gap (HLP, 2016). Furthermore, an efficient and effective value chain leads to fast delivery of aid. Therefore, no one would have to die or live-in deplorable conditions due to a lack of funds or slow response by the aid providers. It would be a significant win for humanity at a crucial time.

Rapid catastrophe response and management are facilitated by RPA. Murphy et al. (2016) discussed the fundamental features of catastrophes and their effect on robotic design, as well as potential robot ideas and designs. Land, water, and air robots have been extensively applied in humanitarian aid relief (Murphy et al., 2016). Disaster response and management require an

efficient value chain if cost and time are to be saved. RPA can be applied in all types of disasters irrespective of their characteristics (Murphy et al.,2016)

To create and sustain superior performance in service delivery during a crisis, humanitarian organizations must adopt an efficient and effective HDRVC. An efficient value chain is created from the way firms organize and operate discrete activities. RPA comes in to automate the secondary activities of the general value chain, providing greater efficiency, saving cost, and increasing productivity in disaster response (Porter, 1985). Consequently, the aid providers gain a competitive advantage and attract even more donations. RPA ensures that the secondary and indirect, repetitive tasks necessary in all disaster responses are handled efficiently and effectively while ensuring timely and cost-efficient aid delivery to the affected communities. Hence the importance of introducing software robots in the planning and preparation phases of the response where these secondary activities are involved.

The humanitarian organizations can use RPA technology to automate these activities at lower cost and faster while promising 24/7 availability and ultimate service delivery, more significant value creation for aid beneficiaries. Value creation in this regard would be through an efficient and compelling value chain geared towards fast, timely, and cost-effective responses to disasters. After all, Porter (2008) insists on a firm's capacity to innovate and upgrade as essential factors leading to its ability to compete in the industry. Organizations can use the RPA technology to provide greater efficiency, save cost, and increase productivity in the HDRVC, hence alleviating the pain of the affected communities.

Preference to use RPA frees money, and the teams needed to care for the affected communities. RPA has made it possible to power “bots” and train them to facilitate interactions between humanitarian agencies and beneficiaries to obtain and disseminate vital information quickly. Instead of spending hours on the phone or behind a desk, employees now have time to engage with and attend to the impacted communities. In turn, the teams are aided by unattended bots that collect, process, and showcase critical information in disaster relief. Implementation and use of RPA in the Humanitarian Disaster Response is chance to use the transformative potential of digital innovation in disaster recovery (Choi-Fitzpatrick, 2014; Haidari et al., 2016; van Wynsberghe & Comes, 2019; Vergouw et al., 2016)

2.6.Analysis of Legal, Ethical, Social and Political Issues in RPA

Robots and algorithms, which are now assuming human decision-making responsibilities and infiltrating the workforce as well as invading our personal lives, are posing legal, ethical, social, and political issues throughout the globe. The usage of robots is acknowledged for both its good and the adverse outcomes of their implementation hence the importance of legal, ethical, social, and political issues considerations in designing and implementing RPA in the industry. The domain of robot ethics was inaugurated at the IEEE-Robotics and Automation Conference in early 2002 (Malle, 2016). Until 2014, the number of literatures on the subject doubled. The two most discussed questions are how humans should implement and deploy robots appropriately, and what moral capacities robots should consist of (Tzafestas, 2018). However, the discussion since then has been to a greater extent directed toward the use of hardware bots (van Wynsberghe, 2015).

Robot ethics are centered around human-robot teaming and any ethical issues resulting from this relationship (van Wynsberghe & Comes, 2019). van Wynsberghe and Comes (2019) state the importance of humanitarian actors concerned about the absence of contextual awareness given to humanitarian workers, leading Shoulder corporate to deskilling. Three ethical concerns exist regarding the beneficiaries: a threat to humanity due to decreased interpersonal interaction, a threat to dignity due to a lack of information transparency, and a threat to dignity due to a lack of accountability for the drone's physiological and behavioral effects on human actors (van Wynsberghe & Comes, 2019).The difficulties and risks inherent in comprehending the physiological and behavioral consequences of bot deployment cannot be overstated. However, it is vital to clearly understand how robots impact humans if they are to be deployed in an ethically appropriate or acceptable way.

The capabilities of RPA are clear especially on the relative ease of its implementation and its ability to boost efficiency and productivity with minimal process change while saving costs. RPA has been connected to disenfranchised communities and local efforts. It exacerbates distant administration and processing issues, which most humanitarian organizations cannot handle (Lichtman & Nair 2015). Humanitarian action's goal is to provide relief to those in need. As a result, humanitarians face physical danger and must devise a strategy for collaborating with totalitarian regimes. Among other hurdles are the challenging decisions on where to focus critical resources and whom and when to accept funding. In addition, this occurs at a period of increasing

budget cutbacks and intense rivalry among humanitarian groups (Comes & Adrot 2016). Slim (2015) states that there has been a development in humanitarian ethics over the last few decades that now serves as a guide for making "proper" decisions in the face of adversity.

Robotics implementations are also faced with social-political implications. With RPA providing eternal life and 24/7 availability and production capacities, implies unrest among staff at the fear of losing jobs as time is implicated which will change tact. Well-coordinated change management during its implementation is necessary to ensure a human-robot foundation is in place. The future vision of central rational AI-hubs outperforming marginalized and disadvantaged regions of the world may increase inequality between the developed and the developing countries (Beerbaum, 2021). Beerbaum (2021) has created a taxonomy to help make the use and uptake of AI-enabled RPA more transparent and ethical.

2.7.User-Robot Interaction in Disaster Response

The approach makes a dynamic and symbiotic relationship between humans and robots, providing industry with a secure and dynamic solution. It is essential to design and construct user-friendly, adaptive, and safe robots. Villani et al. (2018) point out the three main challenges in human-robot collaboration. Safety issues which include the norms of safety and cooperative operation modes are the main primary challenges that must be tackled in implementing human-robot teaming. In addition to this are the intuitive user interfaces that must be executed appropriately if the full advantage of human skills is taken. This will allow easy human-robots interaction focusing on the tasks and goals and minimizing any worries about understanding the interaction. Villani et al. (2018) found that achieving these goals requires addressing design techniques, such as control laws, task allocation and planning approaches. Together, they should enable people to safely share a working space or environment with a robot and actively collaborate on tasks, all while providing the essential system flexibility.

The interaction of the human and robot as partners contributes to the overall success of the mission. de Visser & Parasuraman (2011) states that neither partner is enough on their own. Both partners together, however, demonstrated a significant gain in performance. RPA is user-friendly, and its simple implementation steps provide non-IT staff an exciting work satisfaction while spurring innovation. Implemented in respect to the ethical, social, political, and human-interaction issues promises maximum efficiency and cost-saving taxonomy, which focuses the effort of the

humanitarians to the tasks that matter most in alleviating the pain caused by the natural inflicted catastrophes.

2.8.RPA and Covid-19 Pandemic

Senior management teams have sought operational resilience to boost efficiency ever since the founding of modern enterprises particularly considering the ever-increasing danger of corporate interruption. These disruptions can be caused by civil unrest, cyberattacks, third-party risk, environmental degradation, sociopolitical risk, and catastrophic events, the most recent of which being Covid-19. From outsourcing back-office operations during rightsizing events to integrating enterprise resource planning and data management strategies to control operations in real time, the most successful companies have always been ahead of the curve in their pursuit of ways to eliminate redundancies and associated costs.

Operations, information technology (IT), and finance are the three biggest domains in which RPA has been used successfully, increasing its implementation in other functional areas (Rehr & Munteanu, 2021). The COVID-19 pandemic has expedited the usage of RPA not only in these functional areas but across organizations, both private and public organizations, resulting in a new reality.

In the wake of covid-19, the staff switched to teleworking in huge numbers. The pandemic forced them to interact and communicate to create more digitally enabled corporates and socio-political issues solutions. The lockdown enhanced actor cooperation, allowing the sector to rapidly react to technology advancements for quicker innovation in services, goods, processes, and supply chain, mainly via the repurposing of supply chain facilities to provide services (Queiroz et al., 2020; Leite et al., 2020). The worldwide lockdown's reaction from all industries has highlighted the need to possess the capability to recover and reestablish business processes when faced with pandemics quickly. The stakeholders recognize the critical nature of operational innovation in preparing organizations to be receptive, adaptable, and resilient while being cost effective (Leite et al., 2020). Since then, the humanitarian sector has felt severe restrictions including supply chain management, the increase in remote labor, budget and expense constraints, backlogs in public demand for products and services, and innovative and adaptive solutions to better serve employees and beneficiaries (Doraa & Kumar, 2020).

RPA has faced even more traction in this context, with organizations and institutions making it their baseline solution now embedded in institutions' model of operation. Considering that consumers are more digitally connected and empowered, this has made the speed of delivery an essential competitive advantage aspect for businesses of all types. The expansion of 5G technology will increase this connectedness and transform companies across the nation and the globe. In addition, the rising interdependence of RPA with Artificial Intelligence (AI) and Machine Learning (ML) has given rise to Intelligent Automation, the newest software-based automation concept and trend (IA). RPA has the potential to become an essential component of operational resilience due to its capacity to generate autonomous bots capable of performing human operator jobs.

2.9.Justification of RPA in HDR Value Chain

Preference to use RPA, especially in disaster management, is attributed to its combination of hardware and software, to automate and conduct all activities simply. The use of these RPA functionalities increases efficiency during disaster management, reducing the number of casualties affected by the disaster and during the recovery processes. Preference to use RPA in disaster management has also been linked with its ability to save significant amounts of time while gathering data in the field; they are efficient in their operation and save substantial amounts of dollars (Kerremans, 2018). Evidently, from better data collection to efficient information sharing recognized by the emergency response teams, RPA is preferred to allow disaster response teams to be well prepared and ensure all necessary essential services are delivered to the citizens in need. Additionally, with the increasing number of emergency events occurring across the country, more governments tasked with disaster response must automate and focus on having a digital workforce such as RPA to aid in most operations (Santos et al., 2019). RPA can also be tasked with handling minor tasks that do not require a lot of workforces. Consequently, room for the limited resources is created for disaster management to be used for activities that may require human resources for ethical decisions and even ensure that there is an achievement of complex precision. The use of RPA will create more opportunities to achieve even more in disaster management sectors from the perspective of efficacy, reducing cost, and collecting information that will help understand how the country can further manage the reduction of disaster occurrence.

Using RPA will significantly boost the sector's performance by reducing paying more employees who need to work in the disaster management department. Instead, RPA implementation will foresee a resource allocation process improvement. It will increase the effectiveness of disaster management processes and even create an understanding of disaster patterns (Kerremans, 2018). Additionally, Howell & Torlone (2017) highlight that communication is an integral part of disaster management. It allows the teams in charge of disaster management to obtain crucial information regarding their operations. RPA implementation in the humanitarian context presents a step towards ensuring that their functions are considerate of the repercussions associated with any errors; hence they have a risk management aspect that prefers RPA.

Karn and Kotecha (2021) posits RPA as a future path. They highlight that using RPA and the Internet of Things would be an initiative for the future and towards solving and understanding the occurrence of certain events that can be avoided. Hence, this project hopes to prove that if more investment is made in RPA, the humanitarian sector would be better positioned to handle disaster management effectively and understand how some of these disasters occur and how they can be predicted and avoided.

2.10. Existing Theoretical Frameworks

With the rate of change quickening, it is becoming increasingly critical for a company to develop creative and innovative business processes (Bereznoi, 2014). The analysis of the value chain is influenced by both the internal (production, marketing e.t.c) and external (technological, economic, industry trends, regulations, etc.) factors (Anfara & Mertz, 2015). These components create a value chain's structure and dynamism. Value chain structure affects a company's behavior. The dynamic influences how effectively the value chain functions. Kumar & Rajeev (2016) point out the three triggering elements for the value chain; improved system efficiency, improved quality of service, and developed differentiation in products and services creation all of which can be achieved through integrated business operations and processes. Different frameworks and business models on the value chain and process transformation have been developed to address structure and how its dynamics affect the organizations' growth.

Osterwalder and Pigneur (2010) approach illustrates an organization's value chain via the usage of nine fundamental building pieces in trying to comprehend and describe the current business model, its processes, and the overall value chain. Considering the criticality of innovation in business

processes, developing, visualizing, validating, and concretizing new ideas must be put in a loop. Osterwalder and Pigneur (2010) model can be applied in different industries including the humanitarian sector where the alleviation of pain caused by disasters is the primary goal.

Parmar et al. (2014) propose five patterns of innovation in their model. These patterns shed more light on Identifying current and prospective drivers of digital value within the value chain system. First, use physical item data to improve the business model and operations. Next, employ third-party data sources to allow data sharing between industries. Data trading is the act of selling or transferring data to get more valuable data. In the fifth pattern, quality services can only be delivered if a firm codifies its capabilities (Parmar et al., 2014). A deeper knowledge of digital value drivers helps uncover new business possibilities including those of automation and innovation around organizations.

Hoffmeister (2015) framework recommends not wasting scarce resources in overcrowded business value chain processes. This model challenges conventional strategy reasoning and creates a new value curve.

The Blue Ocean Framework presented by Kim and Mauborgne presents an approach of eliminating, reducing, raising, and creating activities that save organizations from over-engineering and lowers costs by pursuing both distinctiveness and cost leadership simultaneously.

Porter's Value Chain Model posits an organization as a collection of processes and activities that interact with each other to create value. Porter (2008) asserts that each step along the value chain must generate value that is greater than the cost of creation. Porter's model's success in the humanitarian sector comes from its strategy, which emphasizes systems and activities with the client as the primary premise through value chain systems. This model connects systems and activities and illustrates the impact on costs and profit. PGVCM presents a systematic approach in value chain analysis which is exactly in sync with the first stage of RPA implementation; Process Mining. Porter (2008) views value chain modeling as an opportunity to generate value by reducing costs, increasing competitive differentiation, increasing profitability and company success, increasing efficiency, and reducing waste and creating higher productivity which marries well with RPA capabilities. Furthermore, firms obtain competitive advantage through devising new procedures, technologies, or inputs, according to Porter (2008) The model enables value chain

analysis to be applied to the BPM, thus enhancing the process by offering relevant analysis of related business operations to enhance connections and practices that keep beneficiaries happy.

This project uses Porter's value chain as a base for a research framework, to analyze the HDVRC and propose areas where Robotic Process Automation can be applied. This will help organizations identify the best approach to maintaining an efficient and effective value chain in the humanitarian disaster response with RPA as the means of innovation.

2.11. Research framework: Porter's Value Chain Model (PGVCM)

Porter's value chain idea is based on the perception of a service or manufacturing firm as a system with inputs, transformation processes, and outputs and so does Robotic Process Automation. The way value chain activities are conducted influences the organization's costs and profits. Different activities are involved in realizing outputs for different organizations. Porter (2008) distinguishes the primary activities as those with direct value added to a product production from the secondary activities which have indirect contribution to the final product. He further posits a linked value chain where the cost and performance of one value chain activity often affect other ones. Hence the need to ensure that all activities are performed with maximum efficiency and effectiveness through translating any associated challenges into innovative business models.

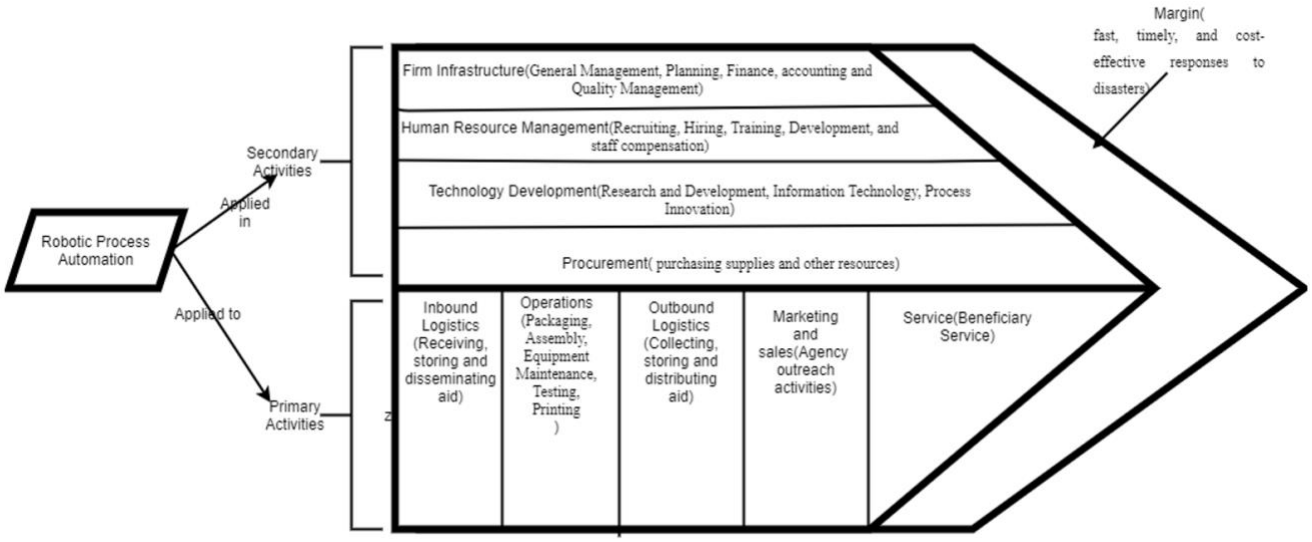

Figure 2.2 Conceptual Research Model based on Porter's Generic Value Chain Model

Interpretation of the Porter Value Chain Model to the study

Table 2.2: Interpretation of PVC framework to the study

	Elements of Porter Value Chain Model	**Interpretation of the framework to the study**
Secondary Activities	Firm Infrastructure	General Management, Planning, Financing, accounting, and quality assurance
	Human Resource Management	Recruitment, training and development, and worker remunerations
	Technology Development	Research and Development, Information Technology
	Procurement	Procurement and Supply - purchasing supplies and other resources required by the organization
Primary Activities	Inbound Logistics	obtaining, storing, and dispersing aid to specified areas
	Operations	Packaging, assembling, maintaining of equipment, testing, and printing
	Outbound Logistics	collecting, storing, and physically distributing packaged to beneficiaries
	Marketing and Sales	
	Service	Beneficiary service

CHAPTER 3: RESEARCH METHODOLOGY

3.1. Research Philosophy

This project used pragmatic research philosophy to obtain credible findings. This mixed approach helps develop an in-depth understanding of a phenomenon and processes (Harper, 2011).

3.2. Research Design

This project used case study design to better understand the WFP operations and how RPA can be applied to its value chain. The project was conducted primarily through a combination of both quantitative and qualitative methods. These two methods are essential in providing abundant data about real-life situations while exploiting the inherent duality of the data analyzed. Furthermore, used simultaneously, they offer study findings grounded in participants' assumptions, behavior, and experiences.

3.3. Source of Data

Quantitative and qualitative data were gathered through surveys with informants from the United Nations World Food Programme in Kenya. Interviews on key participants from the organization were also conducted. The secondary data were gathered from existing studies and publications, such as published papers on the subject matter, humanitarian sector reports and key policy documents among others.

Table 3.1 Source of Data Mapping

Source	**Data**	**Method**	**Importance**
World Food Programme Employees	Disaster Response Value chain Aid Delivery Processes Current costs in aid delivery	Analysis of key sector reports Conducting key informant and focus group interviews	The United Nations World Food Programme is one of the largest United Nations Agencies. As such, it has the most extensive Humanitarian system in the world. Therefore, understanding their process and their value chain gives clear information on what to automate and what automation would be like for even other NGOs.

3.4. Data Collection

Surveys were the main data gathering instruments used in this study. Creswell (2009) explains that a survey allows gathering a large volume of information within a given time. Interview topic guides were devised for the critical interview participants. The study used open-ended and closed-ended surveys to provide qualitative and quantitative data for detailed insights. Interviews covered the value chain processes in disaster response delivery, the value chain execution strategies, value chain process adherence, current value chain limitations, the current value chain processes in disaster response delivery, cost of executing a humanitarian response, inherent costs of value chain processes, the cost of value chain process automation and time taken in disaster response using the current value chain.

Sequential data collection was employed where qualitative data were collected first, and its outputs used in designing of quantitative data instruments. Key issues from the qualitative data were used to map out key issues and approaches to be explored further in the quantitative tools

3.5. Data Analysis

Data cleaning process was applied on the collected data using SPSS. Narrative analysis was applied on the qualitative data. The quantitative data were subjected to descriptive analysis using SPSS statistical analysis tool. The project applied critical analysis of the secondary research data in identifying a research framework strategy and making the data interpretation.

References were made to the background contextual knowledge gleaned earlier from the existing literature and the qualitative data to conclude the study.

3.6. Sampling Frame

Oates (2015) describes a sampling frame as a list of selection of the entire population of individuals that might be included in the survey. The frame for this project was the employees of the United Nations World Food Programme as of 2021 October.

3.7. Sampling Technique

The research participants were chosen using the snow-balling selection technique. Value Chain and automation “champions" selected to fill in the questionnaires. These respondents were then

asked to provide other participants relevant to the topic of the study. The same process used iteratively would then increase the number of participants.

3.8. Sample Size

Slovin Formula selected a suitable sample size. Applied to the population, the method yields a 5% margin of error, meaning there is a 95% confidence level that sampling findings represent the genuine population condition within the provided range precision.

n = N/(1+Ne2)

n-sample size

N- population size

e- marginal error or 0.05

300/(1+300(0.05^2))

171 participants

3.9. Validity and Reliability

Kimberlin and Winterstein (2008) define reliability as the extent to which an instrument is devoid of bias or error, thus ensuring accurate measurement across time and across its different components. The reliability of inter-item consistency is a measure of the correctness of the data gathered by respondents on all the analysis's questions (Kimberlin & Winterstein, 2008; Noble & Smith, 2015). In this study, Cronbach's alpha was utilized to establish whether the data collection instrument would generate appropriate data for analysis.

3.10. Ethical Issues and Consideration

The effectiveness of qualitative and quantitative research methodologies is inherent in their strengths, as previously mentioned, but the credibility of the study is dictated by the researcher's research design. Integrity serves as the foundation for ethics, which is concerned with the professional rules and codes of conduct that govern the researcher's interactions with participants. It is essential to adhere to the ideals of the code of conduct principles to protect the research participants' dignity, rights, and welfare (Santos et al., 2016). Ethics is the stem within which the successful implementation of an educational study is anchored (Daniel, 2016). Berg et al. (2012)

state that researchers must “cause no harm” while collecting data and even communicating results from and to participants. Physical and psychological harms are among the damages caused to human participants in a research study (Daniel, 2016). Consequently, researchers are confronted with treating the participants in the most appropriate ethical manner as the most fundamental issue (Johnson & Christensen, 2012). At the level of research design, the researcher must work out the value of research against the costs/benefits ratio and obtain informed consent upper hand (Creswell, 2009; Bryman, 2011; Cohen et al., 2011)

This study involves vulnerable participants, including women and aid beneficiaries in totality. Hence the need for the research design adopted to be guided by the ethics guidelines. The research put in steps to seek permission from the organization of the study and inform the participants on the purpose and implication of the project and their rights (Cohen et al., 2011). The collection of the data using the questionnaires referred to anonymity and confidentiality and only used for scholarly purposes. The questionnaire was mainly centered on availability, integrity, confidentiality, and the capability of the resource. Berg et al. (2012) pointed out that safeguarding the participants’ data should be the researcher’s primary responsibility.

CHAPTER 4: RESULTS AND DISCUSSION

4.1. Response Rate

The study constituted of 171 employees of the UNWFP as of 2021 October. From the online survey, 71.9% of the respondents participated in the survey by providing feedback on a set of questions, which related to the analysis of the humanitarian disaster response value chain of the United Nations World Food Program. There was a non-response rate of 28.1%. This response rate of the study is sufficient for further analysis of collected data (Morton et al., 2012)

4.2. Reliability Analysis

The research instrument used in the study was subjected to a reliability test during piloting where Cronbach's alpha coefficient was used to determine the extent to which it would generate appropriate data for analysis. The project results present (0.707) Cronbach's alpha for primary value chain activities, (0.756) Cronbach's alpha for secondary activities and (0.712) Cronbach's alpha for the margin activities. A Cronbach's alpha coefficient level of 0.7 and above has been recommended in most studies which suggests presence of internal reliability in the survey tool.

4.3. Demographic Data of the Respondents

The study found that 22.8% of respondents worked in IT, 19.5% in Program, and 22.8% in HR. Other respondents held positions in different functional areas as collated in table 4.1 below. Personnel within the IT section understand the opportunities and challenges associated with implementing RPA in the humanitarian disaster response value chain and thus, provided important insights into this area of scientific inquiry.

Table 4.1: Demographic Information

Demographic Information		**Frequency**	**%**
Functional area in organization	Management	7	5.7
	Programme	24	19.5
	Supply chain management	9	7.3
	Security	9	7.3
	Finance	10	8.1
	Administration	9	7.3
	Information Technology	28	22.8
	Human Resources	14	11.4
	Budget and Programming	5	4.1
	Communication and Reporting	8	6.5
Duration worked	Less than 1 year	9	7.3
	1-2 years	25	20.3
	3-5 years	43	35.0
	More than 5 years	46	37.4
knowledge on compute use	Yes	119	96.7
	No	4	3.3
Nature of work done on the computer	Answering emails	120	97.6
	Analyzing data	103	83.7
	Data entry	94	76.4
	Responding to beneficiary questions	83	67.5
	Support services on 3rd party applications	88	71.5
	Just browsing	69	56.1
	Coding	7	5.7

The second demographic information collected from the respondents was on the length or duration that they had worked with the World Food Program. Results showed that37.4% of the respondents had worked with WFP for a duration of more than 5 years while 35% had been working with the WFP for 3-5 years. In addition, 20.3% had worked with WFP for 1-2 years while 7.3% had been with the organization for less than one year. In this context, majority of the respondents had worked in the organization long enough to possess relevant knowledge, experience, and expertise in the subject matter.

Results on demographic information with regards to respondents' knowledge on computer use pinpointed that 96.7% of the respondents were knowledgeable about computer usage with only 3.3% reporting that they were not conversant with use of computers. This result of the study implies that that almost all employees of the World Food Program possess relevant computer skills, which are important for automating and monitoring tasks to ensure efficient response to humanitarian disasters.

97.6% of WFP staff used computers to answer emails, 83.7% to evaluate data, and 76.4% for data entry, according to the survey. Table 4.1 lists more uses. WFP staff used computers for a wide range of jobs, indicating the organization's ability to adopt RPA to boost the humanitarian disaster response value chain.

4.4. World Food Programme Disaster Response Value Chain

Primary Value Chain Activities

Respondents were asked if they knew about WFP's efforts to respond to catastrophes and deliver help. All respondents (100%) knew about WFP's efforts, according to this study. Respondents were asked to list the major value chain operations of the World Food Program, which fit well with Porter's Value Chain Framework. Table 4.2 summarizes these observations.

Table 4.2: WFP Primary Value Chain Activities

Primary value chain activities	Frequency	%
Inbound Logistics	117	95.1
Outbound Logistics	111	90.2
Operations	123	100.0
Advocacy	75	61.0
Service	100	81.3

**Multiple responses*

Based on the results collated in table 4.2, 95.1% of respondents said inbound logistics was part of the World Food Program's major value chain. In addition, 90.2% of respondents said outbound logistics were key value chain activities of their company, while 100% said operations were core value chain activities of WFP's humanitarian disaster response value chain. Respondents chose advocacy (61%) and service (81.3%) as WFP's key value chain. All primary value chain operations are well-grounded in the World Food Program's humanitarian disaster response value chain, according to the study.

4.4.1.1. Challenges in the primary activities of the value chain

The study sought to understand the specific main challenges in the primary activities of the World Food Program's humanitarian disaster response value chain. Results of the study under this section are summarized in table 4.3.

Table 4.3: Challenges in the primary activities of the value chain

Challenges in the primary activities of the value chain	frequency	%
Poor communication and information dissemination	106	86.2
Implementation difficulties	105	85.4
Insufficient resources	101	82.1
Uncertainty of catastrophes	87	70.7
Pandemic	49	39.8

4.4.1.2. Time required to successfully respond to a disaster

To understand the efficiency of the World Food Program's humanitarian disaster response value chain, the study sought to establish the time required to successfully respond to disasters. Mean, median, and range, among other descriptive statistics were used to analyze this subsection of the study. The results are collated table 4.4.

Table 4.4: Time required to successfully respond to a disaster (In months)

Mean	2.25
Median	2.00
Std. Deviation	1.768
Range	8
Minimum	0
Maximum	8
Sum	214
System Missing	28

The results of the study contained in the table 4.4 show that it takes the World Food Program an average of 2.25 months to successfully respond to a disaster. In some instances, the organization may require a maximum of 8 months to respond to disasters. A standard deviation value of 1.768 demonstrates that the humanitarian organization takes varied number of months to meaningfully address disasters. It is worth noting that 28 employees of WFP did not respond to this question, and as such, the minimum of zero months in responding to disasters is not a true or realistic timeframe.

4.4.1.3. Delays in responding to disasters

In this regard, respondents to the study were provided with a 'yes' and 'no' answer and were expected to state whether there were delays in responding to disasters by the World Food Program. This is as demonstrated in figure 4.1

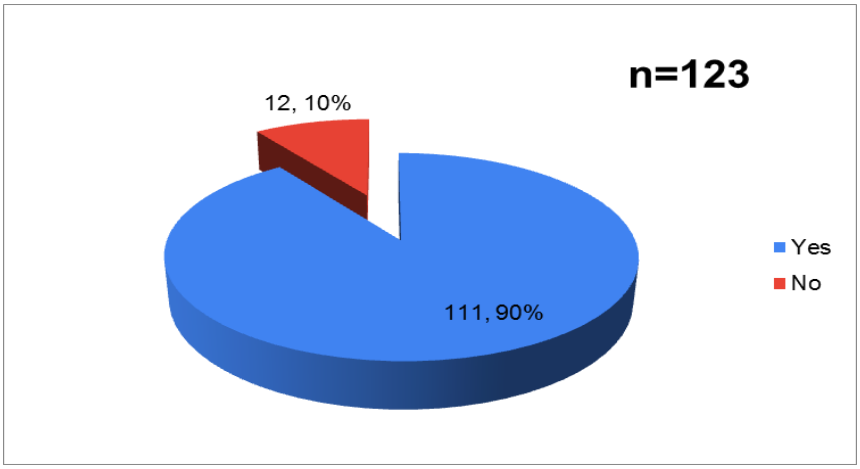

Figure 4.1: Delays in responding to disasters where n is the total number of respondents

4.4.1.4. Causes of delays in the primary activities of the value chain

Respondents who said WFP delayed disaster response were asked a follow-up question. Table 4.5 shows various causes of delays in WFP's key value chain activities.

Table 4.5: Possible causes of delays in the primary activities of the value chain

Possible causes of delays	**Frequency**	**%**
Poor roads and general transport infrastructure	85	72.0
Insufficient funds	79	66.9
Insufficient information	71	60.2
Limited Time	70	59.3
Weather and climate change	69	58.5

4.4.1.5. Communication between actors

Respondents were instructed to indicate the degree to which they agreed or disagreed with the statement that communication between diverse actors before and after a disaster is effective. This subsection's results are summarized in table 4.6.

Table 4.6: Communication between various actors before and after a disaster

Communication between various actors	**Frequency**	**%**
Strongly Disagree	12	9.8
Disagree	5	4.1
Neither Agree nor Disagree	17	13.8
Agree	51	41.5
Strongly Agree	38	30.9

4.4.1.6. Assistance on aid delivery to affected communities

The study sought to understand whether WFP received any assistance during aid delivery. Figure 4.2 provides the summary of the findings.

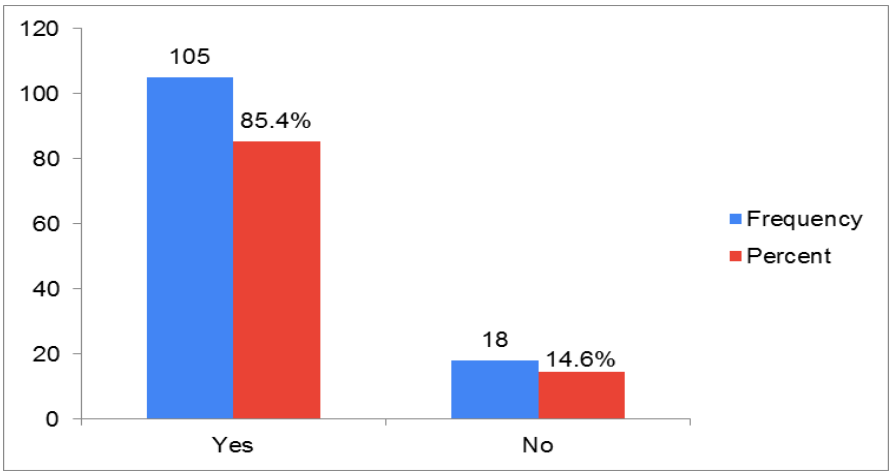

Figure 4.2: Assistance on aid delivery to affected communities

4.4.1.7. Source/Organizations helping on aid delivery

The study sought to establish the organizations that the World Food Program received or sought assistance on aid delivery. This was a follow-up question to the respondents who had indicated that WFP received assistance on aid delivery to the affected communities in the event of a disaster. The results of the study under this subsection are captured in table 4.7 below.

Table 4.7: Source/Organizations helping

Source/Organizations helping	**frequency**	**%**
Other NGOs	86	82.7
Other UN agencies	84	80.8
Government Organizations	82	78.8
Private owned organizations	41	39.4

4.4.1.8. Methods of beneficiary follow-ups before and after a disaster

The respondents were asked to outline the methods, or the way WFP conducted beneficiary follow-ups after a disaster. The results of the study under this subsection are highlighted in table 4.8.

Table 4.8: Methods of conducting beneficiary follow-ups after a disaster

Beneficiaries follow ups after a disaster	**Frequency**	**%**
Manual calls	99	80.5
Manual Texts	82	66.7
Automated solutions	40	32.5
Monitoring, Complaints and Feedback Mechanisms	12	9.8
Remote monitoring	6	4.9

Secondary Value Chain Activities

Secondary value chain activities boost WFP's disaster response indirectly. Respondents were given a list of secondary operations and asked to choose those that comprised WFP's secondary value chain activities. Table 4.9 summarizes the study's outcomes.

Table 4.9: Secondary value chain activities of WFP

Secondary value chain activities of WFP (n=117)	**Frequency**	**%**
Firm infrastructure	51	43.6
Human resource management	36	30.8
Technology development	30	25.6
Procurement	24	20.5

**Where n is the total number of respondents*

4.4.2.1.Activities Supporting Primary Value Chain Activities of World Food Program

The study assessed activities that supported the primary value chain activities of the World Food Program. To achieve this, respondents to the study were presented with a wide range of activities and were expected to select those that they deemed to support the primary value chain activities that have been elucidated in the previous section of this research work. The findings of the study under this subsection are highlighted in table 4.10.

Table 4.10: Activities Supporting Primary Value Chain Activities of WFP

Activities Supporting Primary Activities (n=108)	**Frequency**	**%**
Data and information management	93	86.1
Communication	93	86.1
Organizational Structure and Policy	82	75.9
Technology innovation	80	74.1
Quality Assurance	71	65.7
General Management	69	63.9
Resource mobilization	46	42.6

4.4.2.2 Subcontracting of Secondary Activities/Processes

In effect, respondents to the study were provided with a ‘yes’ and ‘no’ answer where they were required to state if their organization subcontracted secondary activities or not. Figure 4.3 below illustrates the results.

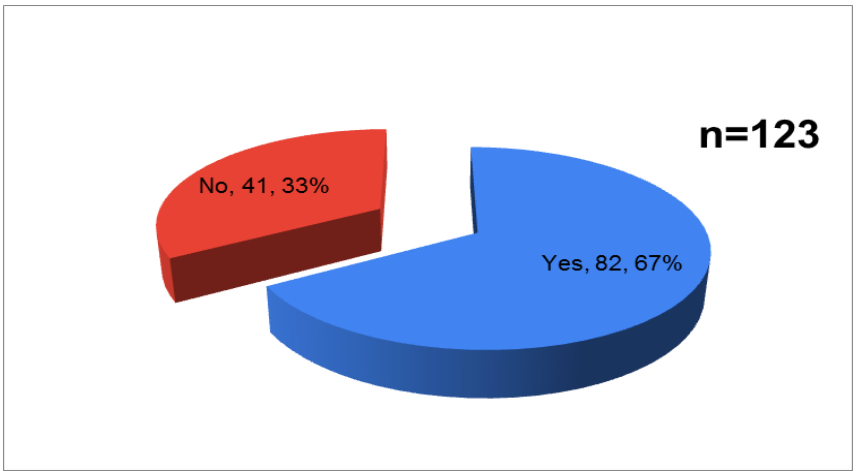

Figure 4.3: Subcontracting of Secondary Activities Processes

The survey also looked for WFP subcontracts. Most respondents neglected to list subcontracted operations, according to the survey. Table 4.11 shows results.

Table 4.11: Subcontracted Activities

Subcontracted Activities	**Frequency**	**%**
Communication	6	4.9
Quality Assurance	17	13.8
Resource mobilization	12	9.8
Technology innovation	6	4.9
Data and information management	6	4.9
*System Missing**	*76*	*61.8*
Total	123	100.0

Reasons for Subcontracting

The study assessed some of the possible reasons as to why the World Food Program subcontracted some of the secondary processes. Table 4.12 below highlights the findings of the study.

Table 4.12 Reasons for subcontracting

Reasons for subcontracting (n=99)	**Frequency**	**%**
Need for collaboration	64	64.6
Insufficient human resources in the organization	46	46.5
Gap in the technical know-how	35	35.4
Reducing the risk internally	6	6.1
separation of functions/conflict of interest	6	6.1
Insufficient funds	5	5.1

Challenges in the Secondary Activities

To achieve this objective, respondents were expected to enumerate those challenges that affected aid delivery and disaster response within the secondary activities. Table 4.13 summarizes the findings of the study under this subsection.

Table4.13: Challenges in the secondary activities affecting aid delivery

Challenges in the secondary activities (n=123)	**Frequency**	**%**
Poor planning	95	77.2
Insufficient internal knowledge and information to conduct these activities	76	61.8
Time delays	69	56.1
Geographical location of the inputs	65	52.8
Insufficient funds	49	39.8
Road and other transportation issues	35	28.5
Delayed funds approval	24	19.5
Electric supply	24	19.5
Crime/corruption	24	19.5
Uncooperative suppliers	18	14.6
Telephone service	11	8.9
Difficult internal team members	6	4.9

Addressing Challenges in the Secondary Activities

After identification of the challenges in the secondary activities that affected aid delivery and disaster response, the study sought to establish the way WFP addressed such challenges. In this regard, innovation solutions were presented to the respondents where they were required to specify the approach adopted by WFP to tackle challenges in the secondary activities. Table 4.13 shows the results of the study.

Table 4.13: addressing challenges

Addressing challenges in the secondary Activities (=116)	**Frequency**	**%**
Design, creation, and implementation of systems	99	85.3
Use of hardware Robots	70	60.3
My organization is not doing anything for now	12	10.3
Use of software robots	10	8.2

**Where n is the number of respondents*

Need for Additional Financing

The study evaluated whether WFP needed additional financing, and how the organization would use the extra. The findings are shown in table 4.14 below.

Table 4.14: Use of Additional Financing

Use of Additional Financing (n=120)	**F**	**%**
Bridging the knowledge gap	94	78.3
Buying new equipment, i.e., computers	82	68.3
Hiring new employees	70	58.3
Outsourcing services	57	47.5

**Where n is the number of respondents*

Equipment/Machinery/Technology for Improving Aid Delivery

The study sought to determine the type of equipment, machinery, and technology that could improve aid delivery experience for the World Food Program and its beneficiaries. These include use of robotic process automation, hardware robots, and automation of the data and information handling processes for easier information availability. Table 4.15 below demonstrate the results.

Table 4.15: Equipment/Machinery/Technology for improving aid delivery

Equipment/Machinery/Technology (n=111)	**Frequency**	**%**
Robotic Process Automation	99	89.2
Automating the data and information handling processes for easier information availability	88	79.3
Use of Hardware Robots	28	25.2

* *Where n is the number of respondents*

Hiring of New Staff at the Onset of a Disaster

In the analysis of the secondary value chain activities, the researcher endeavored to establish whether WFP hired new staff at the onset of each disaster.

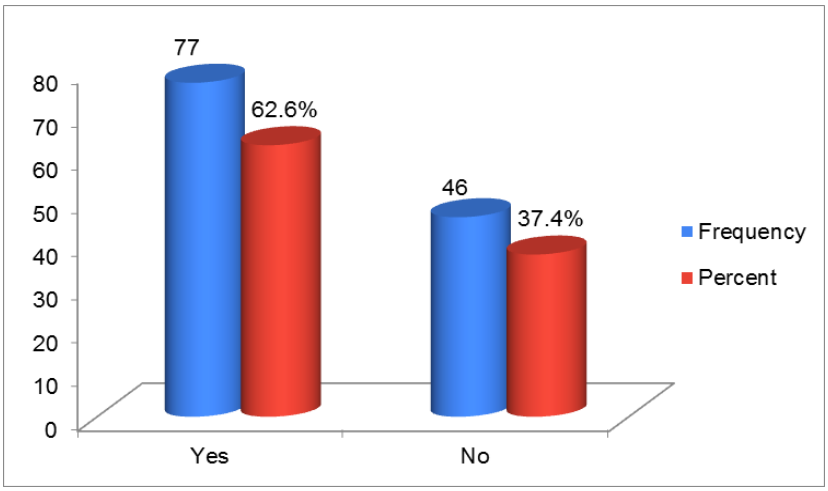

Figure 4.4: Hiring of New Staff at the Onset of a Disaster

The study further assessed the length or duration of contracts that the new personnel were offered at the World Food Program. The length of the contracts was specified as 1-3 months, 3-6 months, 6-9 months, 9-12 months, and more than 12 months. The results summarized in table 4.16 below revealed that new employees were given varying contracts but very few went past 12 months

Table4.16: Duration of contracts for new recruits

Duration of contracts for new recruits (n=123)	**Frequency**	**%**
1-3 Months	47	38.2
3-6 months	23	18.7
6-9 months	30	24.4
9-12 months	17	13.8
More than 12 months	6	4.9
Total	**123**	**100**

* *Where n is the number of respondents*

Besides, the study determined the average number of recruits hired at every onset of a disaster response. The collected data was continuous and thus, it yielded the mean/average, minimum and maximum number of staff hired by WFP at the onset of a disaster. The results presented in table 4.17 demonstrated that WFP hired an average of 12 employees (mean=11.67) with the minimum recruits being 5 and the highest being 20. A standard deviation value of 6.417 demonstrated that WFP hired different number of staff at the onset of disasters.

Table 4.17: number of the recruits hired at every onset of a disaster response

Mean	11.67
Std. Deviation	6.417
Minimum	5
Maximum	20

* *Where n is the number of respondents*

Reasons for Recruitment at the Onset of a Disaster Response

The study appraised the possible reasons as to why the World Food Program carried out recruitments at every onset of a disaster response. The results of the study under this subsection are summarized in table 4.18.

Table 4.18: Reasons for Recruitment at the Onset of a disaster

Reasons for Recruitment at the Onset of a disaster (n=111)	**Frequency**	**%**
Need to prepare for the disaster whose magnitude at this point is unknown	83	74.8
Bridge knowledge gap	55	49.5
Need for technical knowledge that the available staff do not have	53	47.7
Insufficient Skilled available manpower	35	31.5
There is available Funds and there is need to use it	12	10.8

* *Where n is the number of respondents*

World Food Program Value Chain Goal

The value chain of WFP involves a collection of activities carried out by the organization to respond to disasters or crises. WFP has a lot of goals as expressed in table 4.19.

Table 4.19: World Food Program Value Chain Goal

World Food Program Value Chain Goal (n=123)	**Frequency**	**%**
To provide long lasting means of hunger management	117	95.1
To reduce hunger	111	90.2
To provide food and water to the affected communities	107	87.0
To save lives in disasters	100	81.3
To build a pathway to peace, stability, and prosperity for the affected communities	94	76.4
Providing Food Assistance to the affected communities	94	76.4
To use the available resources and reach out to the affected communities in the shortest possible time	88	71.5
To respond to disaster/crises faster and cost efficiently	72	58.5

* *Where n is the number of respondents*

4.4.3.1.Problems with Reaching the Value Chain Goal of the World Food Program

An inquiry was made to decipher any problems or challenges that in anyway hindered WFP from achieving its goal. Table 4.20 demonstrates the results.

Table 4.20: Problems with Reaching Value Chain Goal

Problems with Reaching Value Chain Goal (n=117)	**frequency**	**%**
Insufficient funds	106	90.6
Not enough human resources (staff) to carry out the activities	100	85.5
Transportation issues	48	41.0
Political unrest	47	40.2
Knowledge gap in the organization	40	34.2
Insufficient Time	36	30.8

* *Where n is the number of respondents*

4.4.3.2.Causes of the Problems with Reaching the Value Chain Goal of the World Food Program

The study delved into the causes of the problems that impeded WFP from realizing its value chain goals. The results of the study under this subsection are presented in table 4.21.

Table 4.21: Causes of the problems with reaching the value chain goal

Causes of the problems with reaching the value chain goal (n=119)	**Frequency**	**%**
Mundane and repetitive tasks that unnecessarily take up resources otherwise needed for the goals	89	74.8
Not planning well enough in times of disasters	92	77.3
Data and information not available to aid in decision making	82	68.9
A lot of time taken in analyzing data to create information that can be used to make decisions in responding to disasters	77	64.7

* *Where n is the number of respondents*

4.4.3.3.Beneficiary Numbers Served by WFP

The study sought to find out whether the number of beneficiaries that the World Food program has served increased or decreased over the years. In doing so, the study explored the factors that might have precipitated the increase in the number of beneficiaries. Table 4.22 shows the results with a general indication that the number of beneficiaries served by WFP has increased over the years.

Table 4.22: Reasons for Increased beneficiary numbers

Reasons for increased beneficiary numbers (n=109)	**Frequency**	**%**
Increase in funds donated for the organization	108	99.1
Increased number of staff	49	46.6
Improved roads construction	23	21.1
Automation of mundane tasks	16	13.0
No, the beneficiaries numbers served by WFP have not increased over the years	11	10.1

**Where n is the number of respondents*

4.4.3.4.Activities Carried Out by WFP to Reduce Costs and Increase Performance

An organization's profits and costs are influenced by the way its value chain activities are carried out. In effect, the study sought to establish activities carried out by World Food Program to reduce its costs and increase performance. The findings of the study under this subsection are highlighted in table 4.23.

Table 4.23: Activities Carried Out by WFP to increase performance

Activities Carried Out by WFP to increase performance (n=117)	**Frequency**	**%**
Collaborate with other NGOs and UN agencies to get more help	100	85.5
Hire more staff to carry out the work faster	41	35.0
Borrow more funds to facilitate the process	34	29.1
Automation of some activities	10	10.1

**Where n is the number of respondents*

4.5. Use of Robotic Process Automation (RPA) To Create Efficiency within the Humanitarian Value Chain

Analysis of the World Food Program's primary and secondary value chain activities show that indeed gaps exist in its disaster response value chain, which deployment of robotic process automation will bridge greatly.

Evidently, the humanitarian organization has embraced all the primary value chain activities proposed in Porters' value chain model. Nonetheless, evidence from the synthesized data shows that the World Food Program has not adequately taken into consideration all the secondary activities. For instance, analysis of the support activities revealed that the contribution of financial services, human and resource mobilization services was not satisfactory. Moreover, it is evident that the primary activities of the humanitarian disaster response value chain face a wide range of

challenges, which might be a sharp pointer to the possible malfunctioning of the value chain of the organization. From the assessment, challenges such as, poor communication, and information dissemination, insufficient resources and implementation difficulties affected the WFP delivery of aid to its beneficiaries. Accordingly, RPA is a viable technology innovation, which will facilitate easier management of disasters by promoting communication between humanitarian agencies and the beneficiaries. RPA will ensure that humanitarian teams obtain and disseminate important information efficiently and effectively.

Based on the assessment, the organization takes 8 months to successfully respondent to a disaster. In addition, it was revealed that there were delays in responding to disasters by WFP as supported by 90% of the respondents. These delays have been caused by insufficient information and insufficient funds, among other factors as seen in the results. RPA is a feasible software-based technology, which will provide WFP with an opportunity to improve efficiency and productivity in its humanitarian efforts to affected communities by facilitating faster delivery of aid.

While effective communication existed between various actors, not all respondents generally agreed that there existed. As such, there is an opportunity to apply RPA which can be used to facilitate effective teams' communication and information sharing.

Results show that WFP received assistance from other organizations to deliver aid to affected communities. The implication of this finding is that WFP does not possess a humanitarian disaster response value chain, which can adequately respond on its own to deliver aid to affected communities. A growing wave of empirical evidence shows that humanitarian organizations can utilize RPA to automate a wide range of activities at minimal costs and in a faster way, and more significantly, create value for aid beneficiaries (Kerremans, 2018; Santos et al., 2019). In effect, automation of the value chain process of WFP will enhance understanding of the occurrence of certain crises or disasters and their patterns and thus, plan accordingly on the best response approach to adopt.

Analysis of the WFP disaster response value chain revealed that it subcontracted some of its secondary value chain processes. The activities that were subcontracted included communication, quality assurance, resource mobilization, technology innovation, and data and information management. Moreover, the respondents stated that the need for collaboration, insufficient human resources in the organization, gap in the technical know-how, and insufficient funds, contributed to the WFP subcontracting some of its activities. Whilst the dominant reason as to why WFP

subcontracted its activities was because of collaboration, other factors, such as insufficient human resources in the organization and insufficient funds, can be addressed through automation of the organization's value chain. All these subcontracted activities are those within the capabilities of RPA. Evidence shows that an efficient and effective value chain leads to fast delivery of aid and thus, use of RPA will save costs, promote efficiency of the entire HDRVC.

Results convey that WFP hired new staff at the onset of each disaster because of the need to prepare for the disaster whose magnitude was unknown, including bridging the knowledge gap and the need for technical knowledge on disaster response, which the available staff did not possess. Temporary workers who have been recruited at the onset of a disaster often lack experience to oversee activities during disaster relief efforts. Moreover, they need funds that the organization do not have at the time. As such, deploying RPA will ensure funds are routed to the core business improving the humanitarian response efforts by saving costs and time.

Among other problems in the value chain is the mundane and repetitive tasks that unnecessarily take up resources otherwise needed for the value chain goals, lack of proper planning in times of disasters, and unavailability of data and information to aid in decision making. Evidently, these problems have continued to cause delayed response to the disaster-stricken communities, led to loss of lives, and occasioned unrest among the affected communities. Automation of value chain activities will ensure that repetitive, indirect, and secondary tasks that are critical in disaster response are carried out effectively while promoting cost-efficient and timely aid delivery.

4.6. Potential of Implementing Robotics Process Automation in HDRVC

Assessment of the WFP disaster response value chain demonstrated that the humanitarian organization conducts its beneficiary follow-ups after a disaster majorly through manual calls (80.5%) and manual texts (66.7%). However, it is worth noting that the organization uses automated solutions in undertaking beneficiary follows, albeit to a small extent, as supported by 32.5% of the respondents. In effect, this is an area where WFP can implement RPA to increase the quality of data it collects from beneficiaries. RPA saves time when gathering data in the field and facilitates interaction between beneficiaries and humanitarian agencies by making it possible to acquire and disseminate important information in a quicker manner. In support of this, a respondent posited that, *"Automation is a key especially for routine work and also can help faster response if you have good repository and be able to pull data fast and compare."*

An analysis of the WFP DRVC revealed that it subcontracted some of the secondary processes, such as quality assurance, resource mobilization, technology innovation, and data and information management, because of insufficient human resources in the organization, gap in the technical know-how, insufficient funds, and the need to reduce the risk internally. These areas present a perfect opportunity for automation of the humanitarian value chain processes using RPA. The benefits of deploying RPA are higher than outsourcing or subcontracting of secondary processes of an organization's disaster response value chain. This was supported by a respondent who opined that, *"Automation would be beneficial in ensuring some of these mundane tasks are carried out by trained robots and concentrate the efforts of the available staff on the primary activities or in actually ensuring the robots work well."*

From the evaluation of WFP disaster response value chain, there are inherent challenges in the secondary activities affecting aid delivery and disaster response by this humanitarian organization. The assessment revealed that poor planning, insufficient internal knowledge, and information to conduct the activities, time delays, and geographical location of the inputs affected aid delivery. Employees of WFP stated that their organization addressed the challenges using innovative solutions, such as design, creation and implementation of systems, hardware robots, and software robots. This outcome of the evaluation shows that indeed the organization has taken up innovative solutions to find answers to problems in the secondary activities affecting delivery of aid and the overall manner of responding to disasters. Moreover, this outcome is a sharp pointer that the WFP can take up RPA to further its sustained efforts of addressing challenges in secondary activities that have continued to impede disaster response and delivery of aid. In fact, a respondent to the study pointed out that, *"Software robots would work really well in collaboration with existing staff to offsets costs of time and money that would otherwise go into manual tasks and hiring more recourses."*

The assessment of WFP disaster response value chain noted that there were aspects of the organization that were intended for change within a timeframe of 2 years from the time the evaluation was done. Information gathering and dissemination, data driven decision making, and information management systems were top priority aspects of disaster response, which WFP could potentially change in the next 2 years. These areas requiring change within the WFP disaster response value chain are indeed within the purview of process automation. Furthermore, the participants recommended use of RPA in data and information handling processes for easier

information availability. This was pointed out by a respondent who noted that, *"Automation would speed up routine functions and also give same data to decision makers fast enough."*

The WFP annual performance report for 2020 and the supply chain report for 2019 have documented the need for the humanitarian organization to embrace automation of its processes as the basis of enhancing efficiency in service delivery. The two documents have highlighted the significance of the employees of WFP making sound decisions coupled with simplification of their duties and responsibilities. The WFP supply chain annual report of 2019 set out that the organization should seek to identify the best operational solution, which could improve efficiency of its disaster response. Whilst gaps, challenges, and opportunities within the humanitarian disaster response value chain of the World Food Program have been established, it is important to highlight specific areas where there is potential to implement robotic process automation.

4.7. Validation of Porter's Value Chain Framework in HDRVC

The study used confirmatory factor analysis (CFA) in structural equation modeling to assess and validate Porter's value chain framework as appropriate for HDRVC (SEM). CFA was utilized to put the fundamental notions of Porter's value chain framework to the test. The use of CFA tests was critical in confirming the validity of the individual measures of primary and secondary value chain activities. This was determined by the construct validity and overall fit of the model. A variety of goodness-of-fit (GOF) measurements were used to examine the overall fit of the Porter's value chain framework, including the comparative fix index (CFI), Tucker-Lewis' index (TLI), root mean square error of approximation (RMSEA), and the good-of-fit index (GFI). Table 4.24 summarizes the GOF results.

Table 4.24: Goodness-of-fit Framework Results

	No. of Items	**P**	**GFI**	**TLI**	**CFI**	**RMSEA**
Recommended value (Hair et al., 2014)	NA	>.05	>.95	>.95	>.95	< .05
Firm Infrastructure	5	0.143	0.983	1.000	0.995	0.000
Human Resource Management	3	0.186	0.954	0.976	1.000	0.051
Technology Development	2	0.145	0.999	1.000	0.987	0.001
Procurement	1	0.500	0.976	0.995	1.000	0.000
Inbound Logistics	3	0.382	0.991	0.994	0.980	0.085
Operations	5	0.484	0.976	0.965	0.990	0.000
Outbound Logistics	3	0.372	0.968	1.000	0.985	0.000
Service	1	0.180	0.989	0.967	1.000	0.000
Porter's Value Chain framework	8	0.371	0.990	1.000	1.000	0.000

Based on the GOF results shown in table 4.24 on the validity of the framework using CFA, it is clear that the Porter's value chain framework has a good goodness-of-fit with p-value (0.180), GFI (0.989), TLI (0.967), CFI (1.000), and RMSEA (0.000). The recommended values to demonstrate evidence on the validity of the individual measures based on the framework overall goodness-of-fit are represented in the table's second column (Hair et al., 2014).

Convergent validity, discriminant validity, and factorial validity were tested to evaluate the measurement features of Porter's value chain framework and associated constructs. Construct reliability (CR) testing was performed on each item to determine the framework's convergent validity. A construct reliability of 0.6 to 0.7 is thought to be sufficient to show the presence of convergent validity. Other techniques of determining convergent validity include the average variance extracted (AVE) and the importance of component loadings for all items. Table 4.25 shows that all of the constructions' primary and secondary activities in the Porter's value chain framework meet the acceptable construct reliability standards (0.6 to 0.7). Firm infrastructure (0.77), human resource management (0.72), technology development (0.68), procurement (0.75), inbound logistics (0.69), operations (0.76), outbound logistics (0.62), and service (0.69).

Table 4.25: Convergent Validity Test

	CR	AVE	Description of the indicator variable	SFL
Firm Infrastructure	0.77	0.61	General Management	0.789
			Planning	0.873
			Financing	0.546
			Accounting	0.456
			Quality Assurance	0.893
Human Resource Management	0.72	0.67	Recruitment	0.764
			Training and development	0.765
			Worker remunerations	0.768
Technology Development	0.68	0.65	Research and Development	0.845
			Information Technology	0.897
Procurement	0.75	0.69	Procurement and Supply	0.878
Inbound Logistics	0.69	0.62	Obtaining aid	0.765
			Storing aid	0.784
			Dispersing aid	0.678
Operations	0.76	0.68	Packaging	0.765
			assembling	0.656
			Maintaining of equipment	0.576
			Testing	0.562
			Printing	0.658
Outbound Logistics	0.62	0.60	Collecting	0.645
			Storing	0.574
			Physically distributing packages to beneficiaries	0.768
Service	0.69	0.64	Beneficiary service	0.874

Furthermore, the study's findings reveal that both the primary and secondary activities of the Porter's value chain framework met the specified convergent validity criteria when measured using average variance retrieved (AVE). Table 4.25 shows that the AVE for all constructs was greater than 0.5, demonstrating acceptable convergent validity. Each observed main and secondary activity was significant, as evidenced by standardized factor loading (SFL) values more than 0.5. Following the assessment of convergent validity, if the constructs of the Porter's value chain pass this test, they are subjected to discriminant validity. To assess discriminant validity, the square root of average variance extracted (AVE) and the correlation between the constructs of a model or framework are used. When the square root of AVE is greater than the correlation estimation

between two constructs, they are said to have passed the discriminant validity test. When compared to other value chain constructs or activities, the procurement construct/activity demonstrated the best discriminant validity. The procurement square root of AVE was 0.83, whereas the correlation between procurement and other activities/constructs ranged from 0.174 to 0.2. As a result, it is clear that all constructs have met the acceptable level for discriminant validity because the square root of their AVE is bigger than the correction among the constructs. The discriminant validity test findings of Porter's value chain framework are presented in Table 4.26.

Table 4.26: Discriminant Validity Test

	FI	**HRM**	**TD**	**Procurement**	**Inbound Logistics**	**Operations**	**Outbound Logistics**	**Service**
FI	**0.78**							
HRM	.324	**0.82**						
TD	.478	.365	**0.80**					
Procurement	.085	.046	.007	**0.83**				
Inbound Logistics	.116	.063	.041	.174	**0.79**			
Operations	.054	.091	.005	.046	.074	**0.82**		
Outbound Logistics	.064	.075	.089	.015	.181	.411	**0.77**	.
Service	.065	.079	.068	.027	-109	.264	.129	**0.80**

HRM: Human Resource Management; FI: Firm Infrastructure; TD: Technology Development

The factorial validity test was used to find and eliminate cross-loading items, as well as to establish whether factors that passed the convergent validity and discriminant validity tests represented the same higher-level concept, in this case the World Food Program value chain goal. The study's findings revealed that the final measurement for goodness-of-fit (GOF) was within the acceptable range. The framework's p-value was 0.084, and given that $p>0.05$, it can be concluded that the framework is a good fit for the data. Because the Tucker-Lewis index (TLI) of 0.976, the GOF index of 0.952, and the comparative fit index (CFI) of 0.971 all exceeded the suggested threshold of 0.95, Porter's value chain architecture is reasonably close to a perfect fit. Similarly, the root mean square error of approximation (RMSEA) value of 0.001 is less than 0.05, indicating that the final framework is a good fit. Overall, Porter's value chain model has served as the foundation for this study, which proved that the WFP follows a certain methodology in its reaction to catastrophes and crises.

4.8. Proposed Visual Representation of the Results and RPA Application

Figure 4.5 is a visual representation of how and where humanitarian organizations can apply RPA to achieve maximum effectiveness in their services. The model has been developed from the empirical evidence coupled with the data analyzed throughout the study.

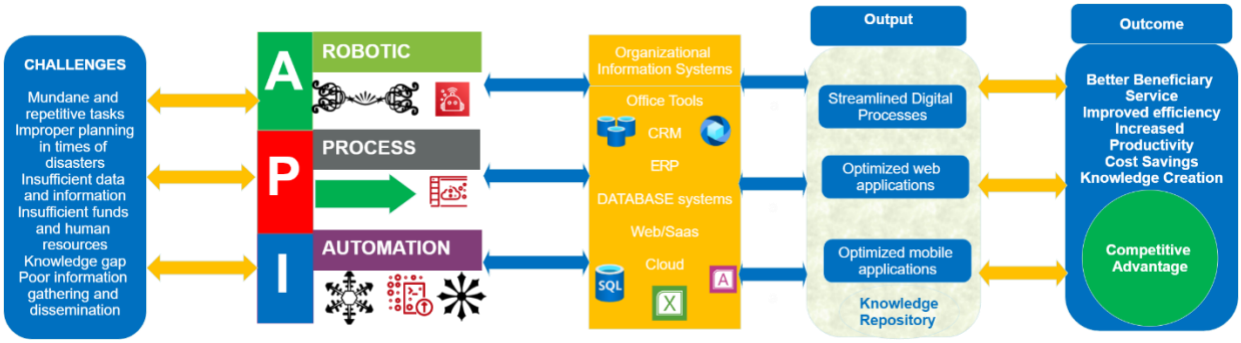

Figure 4.5. Proposed visual representation of the results and RPA integration

Justification

The model is informed by the results of the analyzed data that show various challenges in the HDRVC which the system has been facing. These challenges can be solved by applying RPA to create better services within the humanitarian sector.

Empirical evidence show that RPA can be integrated to turn the identified challenges into the desired outcome of improved beneficiary services, efficiency, productivity, and cost saving as well as knowledge creation which is line with the humanitarian organization's desired state!

RPA makes use of the existing organizations systems to drive output that the humanitarian organizations seek to address.

RPA is commonly utilized in industries like as accounting and auditing. To remain competitive, organizations must combine innovative technologies with the skills and knowledge of competent employees, according to the author of a 2016 KPMG report.

CHAPTER 5: SUMMARY, CONCLUSION AND RECOMMENDATIONS.

5.0. Summary of Findings

Objective 1: To analyze the World Food Programme Disaster Response Value Chain

The analysis found that the WFP practices all Porters' value chain operations. However, the humanitarian organization hasn't considered ancillary value chain operations like security services. Poor communication and information dissemination, insufficient funding, and implementation difficulties hamper the WFP's primary value chain efforts. WFP delays disaster responses due to lack information and money, among other causes. WFP received relief from various organizations, including UN agencies, NGOs, and government agencies.

WFP subcontracted communication, quality assurance, resource mobilization, technology innovation, and data and information management. The organization subcontracted these operations due to a need to collaborate, low funding, and human resources. Poor planning, limited internal expertise and information to undertake activities, time delays, and geographical placement of inputs impacted WFP aid delivery. WFP employed fresh people at the start of each disaster to prepare for the unknown disaster's enormity and to bridge the knowledge gap and requirement for technical disaster response understanding. The results showed that tedious and repetitive tasks, lack of disaster preparation, and lack of data and knowledge created value chain problems.

Objective 2: To evaluate how RPA can create efficiency within the Humanitarian Value Chain.

WFP used robotic process automation to create efficiency in its primary and secondary value chain activities. Poor communication and information dissemination, limited resources, and implementation difficulties plagued the key activities of the humanitarian disaster response value chain, according to the study. Deploying RPA will improve communication between humanitarian agencies and disaster victims, easing disaster management. Automation and RPA will help humanitarian teams get and share information faster.

Insufficient information and finances delayed WFP's response to disasters, according to research. RPA is a possible software-based solution that will help WFP improve its humanitarian efforts by facilitating faster relief distribution. According to the report, WFP got help from other UN agencies, NGOs, and government agencies to distribute aid to affected populations. Automating

WFP's value chain process will improve understanding of crises or catastrophes and their trends, allowing for better response planning.

WFP subcontracted secondary value chain processes like communication, quality assurance, resource mobilization, technology innovation, and data and information management due to insufficient human resources, technical know-how, and funding. Automating the organization's value chain will attract additional funds and participants in its humanitarian initiatives, bridging budget gaps. Secondary activities influenced aid distribution due to planning, poor internal knowledge and information, time delays, and input location. The study suggested that RPA will save costs and improve the World Food Program's humanitarian catastrophe response value chain. The study found that WFP hired new people at the start of each disaster to prepare for an unknown disaster's severity and to fill a knowledge gap and demand for technical disaster response understanding. The study found that tedious and repetitive tasks, lack of disaster preparation, and lack of data and knowledge lead to value chain difficulties. In this context, these regions required value chain automation to ensure that repetitive, indirect, and secondary tasks are carried out properly. Automation and RPA will boost timely, cost-efficient help delivery to needy populations.

Objective 3: To evaluate the potential of implementing Robotics Process Automation in the HDRVC

According to the findings of the study, there were specific areas where there was potential to implement robotic process automation. The results of the study established that WFP conducts its beneficiary follow-ups through manual calls and manual texts while automated solutions are sparingly used. In effect, the results of the showed that this was an area where WFP can implement robotic process automation to increase the quality of data it collects from beneficiaries.

The findings of the study showed that the WFP disaster response value chain was not fully functional since the organization could not manage its workload given that it heavily subcontracted its secondary process because of the factors like insufficient human resources and gap in the technical know-how. Evidence generated from the study showed that the benefits of deploying RPA are higher than outsourcing or subcontracting of secondary processes of an organization’s disaster response value chain. The results of the study further revealed that poor planning, insufficient internal knowledge, and information to conduct the activities, time delays, and geographical location of the inputs affected aid delivery. Moreover, the findings indicated that WFP addressed the aforesaid challenges through design, creation and implementation of systems,

hardware robots, and software robots. This outcome is a sharp pointer that the WFP could take up RPA to further its sustained efforts of addressing challenges in secondary activities that have continued to impede disaster response and delivery of aid.

The results of the study revealed that information gathering and dissemination, data driven decision making, and information management systems were top priority aspects of disaster response, which WFP could potentially change in the next 2 years. These areas requiring change within the WFP disaster response value chain are indeed within the purview of process automation and thus, signaling the potential of the humanitarian organization implementing RPA in its humanitarian disaster response value chain.

Objective 4: To validate the Porter's Value Chain framework as suitable for HDRVC.

The study employed CFA in SEM to validate Porter's value chain concept for HDRVC. Goodness-of-fit of Porter's value chain framework was sufficient with p-value (0.180; $p>0.05$), GFI (0.989; >0.95), TLI (0.967; >0.95), CFI (1.000; >0.95), and RMSEA (0.000; 0.05). The results demonstrated that Porter's value chain framework's constructs, main and secondary activities have adequate convergent, discriminant, and factorial validity. Porter's value chain framework was reasonably near a perfect fit, as shown by p-value (0.084) more than 0.5 and RMSEA (0.001) less than 0.05, as well as TLI (0.976), GFI (0.952), and CFI (0.971) greater than 0.95.

5.1. Conclusion

Results show that humanitarian groups experienced various value chain issues, most of which were driven by gaps in primary and secondary operations. Insufficient resources (human and financial), poor information transmission, insufficient internal knowledge and information, and uncooperative third-party service providers blocked effective aid delivery. This experiment indicated that deploying RPA in HDRVC would ease catastrophe management by solving highlighted problems. RPA streamlines workflows, making companies more flexible, responsive, and competitive. RPA improves staff satisfaction, engagement, and productivity by removing monotonous activities from their regular work. Non-invasive RPA can speed digital transformation in humanitarian organizations.

The final goodness-of-fit measurement demonstrated that Porter's value chain framework was suitable for HDRVC. The validation indicated a p-value (0.084) above 0.5, RMSEA (0.001) below

0.05, and TLI (0.976), GFI (0.952), and CFI (0.971) above 0.95. PVCF analyzes humanitarian value best. These results can help businesses decide which tools to utilize to examine and improve.

5.2. Recommendations

Among the top priority aspects of disaster response that need change in the organization included information gathering and dissemination, data driven decision making, and information management systems which are some of the best suited operations for RPA.

Evidently, it is important to groom the professions in this field to gain computer skills. In so doing, the project seeks to urge the humanitarian organizations to continue working with universities, technology companies, regulators, and other humanitarian organizations to enhance skillsets and develop new capabilities to advance the disaster response quality.

5.3. Further study

As pandemics and disasters proliferate, the humanitarian sector is expected to integrate RPA tools for better disaster response. Therefore, problems exist. Data reliability: How are communicated beneficiary data provenanced? How should humanitarian organizations maintain digital aid delivery evidence to avoid cyberattacks? Humanitarian RPA tools: Which RPA tools are best for humanitarian work? Is combining RPA tools best? HDRVC RPA: What are RPA's challenges? How should we solve these challenges? How should RPA tools be rated in humanitarian work? When should RPA tools be validated?

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APPENDICES

Appendix 1: Sample Quantitative Questionnaire

My name is Sharon Malio. I am a masters student undertaking this research study under the supervision of Christopher A. Moturi at the Department of Computing and Informatics, University of Nairobi.

The purpose of this study is to analyze the WFP Disaster Response Value Chain. The results will be used to identify gaps, opportunities and challenges and recommend areas where Robotic Process Automation can be applied for an effective and efficient Value chain geared towards a cost-efficient and timely response to disasters. These results will be useful to the WFP community, the UN agencies and other NGOs looking to affect their Value chain.

The study requires that key selected participants from the WFP staff community fill in the questionnaire.

The study does not pose any known risk and discomfort. However, feel free to seek any further clarifications when in doubt.

Your participation is highly appreciated, and it will help the us understand the state of the humanitarian disaster response value chain and in return recommend ways in which it can be improved for better beneficiary and staff services.

Your participation is purely voluntary. You reserve the right to refuse to undertake this study. Data collected will only be used for the purpose of this study only. The study does not collect your identifiable/personal information and your responses will be treated with utmost confidentiality

This Survey will take you approximately 10-15 minutes to complete

By clicking yes on the button below, you agree to have read and understood the disclaimer above. *

1) Yes
2) No

Demographic Information

1. What functional area do you belong to within your organization? *
    1) Supply chain management
    2) Management Programme
    3) Security
    4) Finance Administration
    5) Information Technology Human Resources
    6) Budget and Programming
    7) Communication and Reporting
2. How long have you been working with WFP? *
    1) Less than 1 year
    2) 1-2 years
    3) 3-5 years
    4) More than 5 years
3. Do you know how to use a computer? *
    1) Yes
    2) No
4. Do you use a computer in your daily work?
    1) Yes
    2) No

5. Rank yourself on a scale of 1 to 10 on how good you are with using computers? (1-No Idea 10- Expert)

    1 2 3 4 5 6 7 8 9 10

5. What are you mostly doing on the computer for the period specified above?
    1) Answering emails
    2) Analyzing data
    3) Data entry
    4) Responding to beneficiaries' questions
    5) Support services on 3rd party applications
    6) Just Browsing

Primary Value Chain Activities

These are those activities that directly adds value to WFP responding to disasters when communities are affected

1. Are you familiar with the activities taken by WFP to directly assist in successfully responding to a disaster or delivering aid?
    1) Yes
    2) No
2. If answered yes to the above, what broad activities make the primary value chain for WFP? (Select all that apply) *
    1) Inbound Logistics
    2) Outbound Logistics
    3) Operations
    4) Advocacy
    5) Service:
3. What activities support the primary activities mentioned above? (Select all that apply) *
    1) Planning
    2) Information dissemination/Communication
    3) Financial, human and other resource mobilization
    4) Security services
    5) Administration services
    6) Strategic data and information gathering and processing
    7) Strategic Managerial Decision Making
    8) Strategic Initiatives Implementation
    9) Direct Services and Transactions
    10) Software systems design and implementation
    11) External Audit and Evaluation
    12) Advocacy and Partnerships
4. What are the main challenges in the primary activities of the value chain?(Select all that apply)
    1) Poor Communication and information dissemination
    2) Insufficient Resources (eg. Funds, human and material)
    3) Pandemic

4) Uncertainty of catastrophes
5) Implementation difficulties

5. On average what is the time required to successfully respond to a disaster(In months)

6. Are there usually delays in responding to a disaster? *
   1) Yes
   2) No
7. If answered yes to the above question, in your opinion what are the possible causes of any delays experienced in the primary activities of the value chain? (Select all that apply)
   1) Weather and climate change
   2) Poor roads and general transport infrastructure
   3) Insufficient funds
   4) Insufficient information
   5) Limited Time
8. To what extent do you agree with the statement below? (1-Strongly Disagree, 2-Disagree, 3- Neither agree nor disagree, 4- Agree, 5- Strongly Agree)
   1) The communication between various actors before and after a disaster is very effective
9. Do you receive any assistance on aid delivery to the affected communities in the event of a disaster?
   1) Yes
   2) No
10. If answered yes to the above question, from which sources or organizations do you seek/receive assistance from? (Select all that apply)
    1) Other NGOs
    2) Government Organizations
    3) Other UN agencies
    4) Private owned organizations:
    5) How do you conduct beneficiary follow ups after a disaster? (Select all that apply)
    6) Manual calls
    7) Automated solutions

8) Manual Texts

Secondary Value Chain Activities

Those activities that indirect support the goal of WFP responding to disasters. These activities usually support the primary value chain activities

1. What general category activities belong to the secondary value chain activities of WFP? (Select all that apply)
   1) Firm Infrastructure
   2) Human Resource Management
   3) Technology Development
   4) Procurement

11. What activities do you believe support the primary value chain activities stated in the previous section? (Select all that apply)
    1) General Management
    2) Technology innovation
    3) Resource mobilization
    4) Quality Assurance
    5) Organizational Structure and Policy
    6) Data and information management
    7) Communication

12. Do you subcontract any of the above processes?
    1) Yes
    2) No

13. If yes, of the activities mentioned above, please mention the subcontracted ones

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14. For what reason does your organization feel the need to subcontract?
    1) Insufficient human resources in the organization
    2) Need for collaboration
    3) Gap in the technical know-how
    4) Insufficient funds

15. What are some of the challenges in the secondary activities affecting aid delivery and disaster Response?
    1) Uncooperative suppliers
    2) Difficult internal team members
    3) Delayed funds approval
    4) Telephone service
    5) Electric supply
    6) Insufficient Funds
    7) Crime/corruption
    8) Insufficient internal knowledge and information to conduct these activities
    9) Poor planning
    10) Road and other transportation issues
    11) Geographical location of the inputs Time delays
16. What is your organization doing about these Challenges? Especially around innovation?
    1) Design, creation, and implementation of systems?
    2) Use of hardware Robots?
    3) Use of software robots?
    4) My organization is not doing anything for now
17. Do you have a need for additional financing at the moment? If so, what would it be used for?
    1) Hiring new employees
    2) Outsourcing services
    3) Buying new equipment's i.e., Computers
    4) Bridging the knowledge gap
18. Which aspects of disaster response do you intend to change in the next 2 years, if any?
    1) Information gathering and dissemination
    2) Data driven decision making
    3) Shipping
    4) Storage
    5) Purchasing
    6) Distribution
    7) Branding

8) Packaging
9) Information Management Systems
10) Hiring more staff

19. Why would you like to change the aspects selected above?

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20. What kind of equipment/machinery/technology could improve aid delivery experience for you and the beneficiary?
    1) Robotic Process
    2) Automation Use of Hardware Robots
    3) Automating the data and information handling processes for easier information availability
21. Do you hire new staff at the onset of each disaster?
    1) Yes
    2) No
22. On average how long are the contracts for the new recruits?
    1) 1 - 3 month
    2) 3-6 months
    3) 6-9 months
    4) 9-12 months
    5) More than 12 months
23. What's the average number of the recruits hired at every onset of a disaster response?

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24. What is the main reason for the recruitment at this stage? (Select all that apply)
    1) Insufficient Skilled available manpower
    2) Need to prepare for the disaster whose magnitude at this point is unknown
    3) There is available Funds and there is need to use it
    4) Need now knowledge that the available staff do not have
    5) Bridge knowledge gap

Margin

1. What is the organization's value chain goal? (Value chain in this context is the collection of activities/actions carried out by WFP to respond to crises and/or a disaster when it happens)
    1) To build a pathway to peace, stability and prosperity for the affected communities
    2) To save lives in disasters
    3) Providing Food Assistance to the affected communities
    4) To use the available resources and reach out to the affected communities in the shortest possible time
    5) To respond to disaster/crises faster and cost efficiently
    6) To reduce hunger
    7) To provide long lasting means of hunger management
    8) To provide food and water to the affected communities

25. What are the main problems with reaching the goal
    1) Insufficient funds
    2) Not enough human resources(staff) to carry out the activities.
    3) Transportation issues
    4) Political unrest
    5) Knowledge gap in the organization
    6) Insufficient Time

26. For the problems in the question above, what do you think is the cause?
    1) Mundane and repetitive tasks that unnecessarily take up resources otherwise needed for the goals
    2) Not planning well enough in times of disasters
    3) Data and information not available to aid in decision making
    4) A lot of time taken in analyzing data to create information that can be used to make decisions in responding to disasters

27. What are the consequences of the first three priority problems?
    1) Delayed Response to the disaster-stricken communities
    2) Loss of lives of some victims of these disasters
    3) Unrest of the affected communities

28. Has the organization beneficiary numbers (The numbers WFP has served over the years) been increasing over the years? If yes, what are the reasons?

1) Increase in funds donated for the organization
2) Improved roads construction
3) Automation of mundane tasks
4) Increased number of staff
5) No, the beneficiaries numbers served by WFP have not increased over the years Other:

29. What activities are you carrying out to reduce costs and increase performance?

1) Automation of some activities
2) Hire more staff to carry out the work faster
3) Collaborate with other NGOs and UN agencies to get more help
4) Borrow more funds to facilitate the process

Appendix 2: Sample Qualitative Questionnaire

Section 1

Robotic Process Automation - It is a software-based methodology for automating processes via the use of technology that is guided by business logic and structured inputs

Primary Activities - These are those activities that directly adds value to the organization responding to disasters when communities are affected for example - inbound and outbound logistics

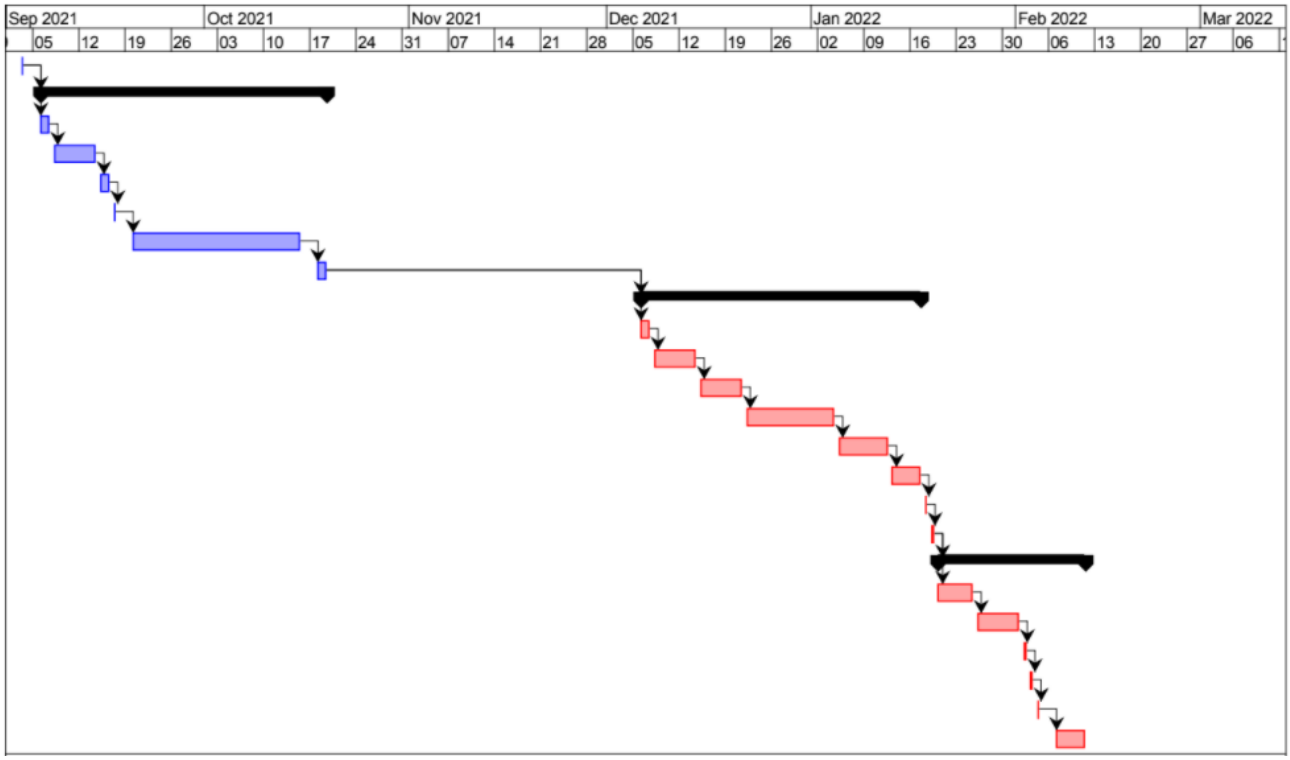
Secondary Activities - These are those activities that indirectly support the goal of the organization responding to disasters. These activities usually support the primary value chain activities, for example IT and Finance

1. What is the relationship between the primary activities and the secondary activities of the disaster response Value Chain? How do you deal with the interdependency between these two?
2. What are some of the activities that the organization is looking to improve and in which ways?
3. Do you subcontract any of these activities? (Primary or secondary) If yes, for what reasons? *
4. Do you think Automation would be beneficial to you and your organization? In which ways?

5. What are some of the challenges in the activities that the organization and facing right now? *
6. What would Automation of the activities mean to you and to your organization? *
7. Are there any open opportunities in which RPA can be applied to bring the benefits mentioned above? What are these opportunities? *
8. What defines a successful disaster response? *

Appendix 3: Project Schedule

		Name	Duration	Start	Finish	Predecessors	Resource Names
1		Milestone 1 Presentation o...	1 day?	9/3/21 8:00 AM	9/3/21 5:00 PM		
2		**Data collection plan**	**32 days?**	**9/6/21 8:00 AM**	**10/19/21 5:00 PM**	**1**	
3		Finalize the sampling plan	2 days?	9/6/21 8:00 AM	9/7/21 5:00 PM	1	
4		Define the data to be col...	5 days?	9/8/21 8:00 AM	9/14/21 5:00 PM	3	
5		Test the data collection t...	2 days?	9/15/21 8:00 AM	9/16/21 5:00 PM	4	
6		Refine the data collectio...	1 day?	9/17/21 8:00 AM	9/17/21 5:00 PM	5	
7		Carry out data collection	20 days?	9/20/21 8:00 AM	10/15/21 5:00 PM	6	
8		Draft data collection sec...	2 days?	10/18/21 8:00 AM	10/19/21 5:00 PM	7	
9		**Data Refinement, anal...**	**31 days?**	**12/6/21 8:00 AM**	**1/17/22 5:00 PM**	**8**	
10		Prepare data for analysis	2 days?	12/6/21 8:00 AM	12/7/21 5:00 PM	8	
11		Perform open coding for ...	5 days?	12/8/21 8:00 AM	12/14/21 5:00 PM	10	
12		perfom axial coding for t...	5 days?	12/15/21 8:00 AM	12/21/21 5:00 PM	11	
13		Perform descriptive anal...	10 days?	12/22/21 8:00 AM	1/4/22 5:00 PM	12	
14		Visualize the data	6 days?	1/5/22 8:00 AM	1/12/22 5:00 PM	13	
15		Draw conclusins/Recom...	3 days?	1/13/22 8:00 AM	1/17/22 5:00 PM	14	
16		Review draft with supervisor	1 day?	1/18/22 8:00 AM	1/18/22 5:00 PM	15	
17		Milestone 2 Presentation	1 day?	1/19/22 8:00 AM	1/19/22 5:00 PM	16	
18		**Project Writeup**	**17 days?**	**1/20/22 8:00 AM**	**2/11/22 5:00 PM**	**17**	
19		Final Draft Report	4 days?	1/20/22 8:00 AM	1/25/22 5:00 PM	17	
20		Iteratively Review Draft ...	5 days?	1/26/22 8:00 AM	2/1/22 5:00 PM	19	
21		Milestone 3 presentation	1 day?	2/2/22 8:00 AM	2/2/22 5:00 PM	20	
22		Final Editing of the report	1 day?	2/3/22 8:00 AM	2/3/22 5:00 PM	21	
23		Review with Supervisor	1 day?	2/4/22 8:00 AM	2/4/22 5:00 PM	22	
24		Printing, Binding and Fin...	5 days?	2/7/22 8:00 AM	2/11/22 5:00 PM	23	


Sep 2021
Oct 2021
Nov 2021
Dec 2021
Jan 2022
Feb 2022
Mar 2022
05 12 19 26 03 10 17 24 31 07 14 21 28 05 12 19 26 02 09 16 23 30 06 13 20 27 06