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Digitalisation and efficient humanitarian logistical operations in Zimbabwe

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ABSTRACT

This study explores the transformative impact of digitalisation on the efficiency of humanitarian logistical operations in Zimbabwe. Drawing on survey responses from 286 participants in humanitarian aid organisations, the research employs rigorous multiple regression analysis to scrutinise the predictive significance of various digitalisation elements. The findings illuminate robust positive associations between digitalisation components, including communication effectiveness, cost reduction, automation, sustainability, organisational size, and the enhancement of efficient humanitarian logistics. Notably, the integration of digitalised supply-chain management systems, such as barcode readers and tracking solutions, emerges as pivotal in fostering improved information management and co-ordination. The study also brings attention to challenges, such as knowledge-sharing barriers and heightened vulnerability to cyber security threats. Contributing to theoretical frameworks, this research emphasises the contextual relevance of digitalisation in Zimbabwe's specific setting. Practical implications underscore opportunities for aid organisations to optimise operational efficiency through informed digitalisation initiatives. The study further identifies key variables for technology adoption frameworks and introduces a culturally relevant focus on Zimbabwe within the field. Strategic recommendations advocate for investments in digital infrastructure, robust security measures, and collaborative tools. Managerial implications underscore the importance of prioritising knowledge-sharing initiatives and forming strategic partnerships with technology companies to address challenges. Theoretical implications support information systems theories and illuminate causal relationships between distinct facets of digitalisation and efficient humanitarian logistics. The study concludes by acknowledging its limitations, including a Zimbabwe-centric focus, potential response bias, and the utilisation of a cross-sectional design. Future research recommendations advocate for longitudinal studies, comparative analyses across diverse regions, and qualitative investigations into the human and organisational factors influencing the adoption of digital solutions. Overall, this study contributes invaluable insights for both theoretical development and practical applications in the dynamic landscape of humanitarian logistics and digitalisation in Zimbabwe.

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1. Introduction and background

The global humanitarian aid environment is increasingly becoming more intricate, necessitating a deeper understanding of conflict in all its forms, security issues, pandemics (such as COVID-19), natural disasters (such as the earthquake that has just engulfed Southern Turkey and North-Western Syria in February 2023, earth movements, and volcanoes), as well as local and international political trends (Dhingra, 2023; Mbohwa, 2010). The earthquake situations in Turkey and Syria, and again, the war situation in Ukraine,

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all demand international cooperation to expedite search and rescue attempts, as well as digitalised humanitarian logistical help (Dhingra, 2023; Noe, 2022; Relief Web, 2023).

Digitalisation involves transforming humanitarian aid delivery in risky and crisis-stricken countries like Turkey, Syria, Hawaii, Texas (USA), and Ukraine, according to Capgemini Consulting (2019). The availability and use of cell phones and social media by humanitarian disaster victims, geo-spatial innovations and unmanned aerial vehicles (UAVs) to track humanitarian crises, the use of biometric identification to facilitate humanitarian aid, and a switch to electronic payments as relief provisions with e-vouchers and digital cash are all changing the humanitarian aid landscape (Anson et al., 2017).

With each tragedy, a number of humanitarian and/or relief efforts are launched, all of which rely heavily on logistics (Gitonga & Samson, 2022). The major goal of humanitarian logistics (HL) is to meet basic human requirements, decrease human suffering, deliver humanitarian services and products most efficiently and responsively, prevent and prepare for catastrophes, and make the situation better and quicker (Khan & Lee, 2019). HL encompasses all logistical tasks, from preparation to recovery, and its fundamental operations include delivering correct supplies to the appropriate people at the correct time, location, and quantity while also evaluating relief requirements, preparing for emergency rescue circumstances, inventory, as team management, organised relief materials, and last-mile distribution management (Ardaya et al., 2017; Khan & Lee, 2019).

Digitalising HL operations can improve speed, fairness, and safety, according to recent studies (Iqbal & Ahmad, 2022; Kersten et al., 2017; 2017; Rodríguez-Espíndola et al., 2020). Technology-based tracking of resource movements from depots to beneficiaries ensures speedy, fair, and safe resource distribution and efficient resource management (Khan et al., 2022). It improves HL accountability, safety, trust, openness, and speed (Iqbal & Ahmad, 2022). According to Chingono and Mbohwa (2016), HL applications include supply-chain planning, transaction processing and cooperation, and order delivery and tracking co-ordination (order expedition). Research shows that due to improved targeting, analytics, and efficiency, digital solutions can scale responses in resource-constrained situations (Bryant, 2022; Marić et al., 2022; Saruchera & Mpunzi, 2023).

Even though digitalisation is getting more and more attention in HL, the situation in Zimbabwe is still not fully explored in the available literature. There has been much talk about global cases, but the unique social, political, and infrastructure problems that aid entities in Zimbabwe may show different examples of how well digitalisation works. Not much study has been conducted on how Zimbabwean aid groups use digital logistics for humanitarian work when there are problems with local infrastructure, politics, and resources (Agrawal & Cooper, 2020; Narasimhan et al., 2018). There is a need for a more in-depth look into the unique problems these organisations face in Zimbabwe. This will help us understand how digitalisation efforts interact with the realities of life in Zimbabwe and the African region (Chingono & Mbohwa, 2016; Shafiq & Soratana, 2019; Shumba & Saruchera, 2023).

Also, most of the current discourse is about the good things that could happen with digitalising HL operations, like making it easier to be accountable, clear, and quick to respond (Khan et al., 2022). Nevertheless, there is still a lack of real-world data that looks at how digitalisation actually affects operational efficiency in the Zimbabwean humanitarian aid landscape (Rahimi & Mohebbi, 2021). Because of this gap, it needs to be carefully looked into whether using digital solutions in logistics really does make humanitarian endeavours in Zimbabwe more efficient, cut down on response times, and make better use of resources. Furthermore, controversies encircling cybersecurity vulnerabilities, data privacy, and the digital gap in marginalised communities continue being underexplored within the framework of Zimbabwean humanitarian aid efforts (Chopra & Sodhi, 2019; Tatham & Kovács, 2023). It is very important to address such worries in order to fully grasp the overall effects of digitalising aid logistics in Zimbabwe and make sure that it works in a moral and useful way (Chingono & Mbohwa, 2016).

The digitalisation of humanitarian logistical operations in Zimbabwe and abroad faces a myriad of challenges, the list of which remains inexhaustive (Aranda et al., 2019; Chingono & Mbohwa, 2016). Government employees and volunteers involved in HL and disaster risk operations lack the technological expertise to support and implement digitalisation in humanitarian operations (Iqbal & Ahmad, 2022). HL digitalisation also struggles with a lack of funding, a lack of transparency in its governance, and a pervasive corruption culture (Khan et al., 2020). Additionally, the development of information solutions that can trace the flow of resources in the HL supply chain, as well as the adoption and deployment of digital solutions to ensure

efficiency in HL, demands substantial financial resources (Prusty & Mohanty, 2019). While there are new opportunities for communication in challenging situations thanks to digital technologies, volunteer and humanitarian groups lack sufficient standards or ethical guidelines that have been authorised by governments throughout the world (Dzhennet-Mari & Malika-Sofi, 2020).

The study's main purpose is to analyse digitalisation as a predictor of efficient humanitarian logistical operations in Zimbabwe. To achieve this, specific research questions (RQs) were formulated as follows:

RQ1: What are the various digitalised humanitarian logistical operations undertaken by Zimbabwean aid organisations?
RQ2: What are the challenges that most aid organisations in Zimbabwe encounter as they digitalise their humanitarian logistical operations?
RQ3: How does digitalisation influence the efficiency of humanitarian aid operations (logistics)?

The research paper is outlined as follows: Introduction (encompassing the introduction and background, the problem statement, and the purpose of the study); Literature review (which includes humanitarian logistical, operational types, challenges faced by aid entities during digitalisation, the influence of digitalisation on the efficiency of HL operations, the theoretical framework, and the conceptual framework); Methodology; Results and discussion (respondent characteristics, reliability test, descriptive analysis, multi-collinearity, and multiple linear regression); Implications of the study; Conclusions; Limitations of the study; and Suggestions for future studies.

2. Literature review

This section reviews the empirical contributions of various contributors from extant literature on the influence of digitalisation on efficient humanitarian logistical activities. Besides the extension of research objectives, both theoretical and conceptual frameworks were reviewed or developed.

2.1. Various types of humanitarian logistical operations

Humanitarian logistics in Zimbabwe and abroad take various forms (types), and these are discussed below:

2.1.1. Supply-chain management

The process of digitalisation is of paramount importance in the effective management of the supply chain for humanitarian operations (Moeiny & Mokhlesi, 2013). These activities encompass demand forecasting, inventory management, procurement, distribution, and warehouse management (Gezgin et al., 2017). The utilisation of digital technologies and tools, like supply-chain management programmes, barcode readers, and tracking solutions, facilitates instantaneous visibility, effective inventory management, and optimised distribution processes (Maghsoudi & Moshtari, 2020).

2.1.2. Transportation and fleet management

Digitilisation has been found to enhance the efficiency of transport and fleet operations in the context of humanitarian logistics (Gavalas et al., 2022; Mogotsi & Saruchera, 2023). This comprises various aspects such as developing a route plan, monitoring the movement of vehicles, managing fuel consumption, scheduling maintenance activities, and overseeing the performance of drivers (Balci & Surucu-Balci, 2021). Digital technologies such as GPS tracking, fleet management systems, and telematics mechanisms have facilitated the ability of aid organisations to enhance their route optimisation capabilities and effectively monitor their vehicle fleet (Maghsoudi & Moshtari, 2020; Thomas, 2008).

2.1.3. Management and co-ordination of information

Efficient co-ordination and proficient information management are essential components in the realm of humanitarian operations (Gunasekaran et al., 2018). Digitalisation facilitates the gathering, examination, and dissemination of information in order to enhance comprehension of a given situation, the ability to make

informed choices, and the co-ordination of efforts among various parties involved (Gitonga & Samson, 2022). The utilisation of digital platforms, communication tools, and information management systems enables entities to exchange up-to-date information regarding needs, response efforts, and resource availability, thereby promoting enhanced co-ordination among concerned actors (Tatham et al., 2017).

2.1.4. Cash and voucher assistance (CVA)

The utilisation of digitalisation has brought about a significant transformation in the provision of cash as well as voucher assistance within the context of humanitarian operations (Kreidler & Reiger, 2022). Rather than dispensing tangible commodities, humanitarian organisations are progressively furnishing monetary funds or coupons to impacted communities, allowing them to fulfil their fundamental requirements (Geo-spatial World, 2014). The utilisation of digital payment mechanisms, mobile money systems, and biometric authentication systems has been instrumental in facilitating the safe and efficient delivery of cash transfers (Maghsoudi & Moshtari, 2020). This has enabled beneficiaries to access vital services and products conveniently.

2.1.5. Registration and identification of beneficiaries

Digital systems are used for the purpose of registering and identifying beneficiaries, thereby guaranteeing precise and open targeting of aid (Heymann, 2017). These systems are designed to collect demographic information, monitor beneficiary profiles, and administer distinct identification numbers (Iqbal & Ahmad, 2022). The utilisation of biometric technology, digital registration platforms, and mobile data-gathering tools has been shown to improve operational efficiency, mitigate fraudulent activities, and facilitate more precise delivery of aid (Ardaya et al., 2017) (Table 1).

2.1.5.1. A critical approach. **Methodological limitations:** The available literature (Ardaya et al., 2017; Balci & Surucu-Balci, 2021; Gavalas et al., 2022) does not always use the same methods in different studies. A rigorous empirical study using a variety of methods is needed to give a full picture of the difficulties and successes of using digital solutions in different humanitarian situations.

Contextual consideration: Most studies (Gunasekaran et al., 2018; Iqbal & Ahmad, 2022; Moeiny & Mokhlesi, 2013) only look at the benefits of digitalisation in perfect or developed settings, ignoring how hard it is to apply in places with few resources, much conflict, or a lack of connectivity. To get a full picture of how digitalisation has changed humanitarian operations, it is important to look at these contextual issues.

Table 1. An empirical assessment of types of humanitarian logistical operations.

Aspect	Positive digitalisation factors	Critical evaluations and limitations
Supply chain management	Improves inventory management, visibility, and distribution processes (Maghsoudi & Moshtari, 2020; Moeiny & Mokhlesi, 2013).	Limited emphasis on scalability issues and efficiency of digital tools under resource-constrained contexts (Gezgin et al., 2017; Maghsoudi & Moshtari, 2020).
Transportation and fleet management	Enhances route optimisation and fleet monitoring (Gavalas et al., 2022; Thomas, 2008).	Insufficient exploration of digital solutions' scalability in conflict-affected/remote areas with negligible infrastructure (Balci & Surucu-Balci, 2021; Maghsoudi & Moshtari, 2020).
Information management	Facilitates better co-ordination and real-time exchange of information (Gunasekaran et al., 2018; Tatham et al., 2017).	There is no focus on data privacy, security, and inter-operability issues among various digital platforms (Gitonga & Samson, 2022; Wilson & Jumbert, 2018).
Cash and voucher assistance	Enables efficient and safe cash transfer delivery (Heymann, 2017; Iqbal & Ahmad, 2022).	Inadequate study of the potential exclusion of susceptible populations owing to limited access to technology (Ardaya, Evers, & Ribbe, 2017; Maghsoudi & Moshtari, 2020).
Beneficiary registration	It enhances operational efficiency and mitigates fraud (Heymann, 2017; Iqbal & Ahmad, 2022).	Limited exploration of ethical concerns and potential biases in utilising biometric technologies for beneficiary identification (Ardaya et al., 2017; Heymann, 2017).

Source: Authors' depiction (2023).

Ethical implications: Not enough research has been done on the ethical implications of using digital technologies in humanitarian aid. More research needs to be done on the possible biases, privacy concerns, and unexpected effects on vulnerable groups in order to make sure that practices are fair and honest for everyone.

Cost-benefit analysis (CBA): Conducting a comprehensive cost-benefit analysis (CBA) of integrating digital solutions into humanitarian logistics (HL) operations is crucial, even though it was briefly mentioned. Non-governmental organisations (NGOs) operating on limited budgets must grasp the implications for sustainability, long-term financial outcomes, and the overall affordability of digitalisation.

Digital gap and accessibility: The effects of the digital gap on aid delivery have not been studied in depth in the literature (Balci & Surucu-Balci, 2021; Bryant, 2022; Maghsoudi & Moshtari, 2020). It is very important to look into ways to make sure that everyone has equal access to technology, especially in areas that are marginalised or have been through war.

2.2. Challenges most aid entities encounter as they digitilise their logistical operations

Quite a number of obstacles affect the firms' efforts to digitilise their logistical operations, and these are discussed below:

2.2.1. IT/data management

Information and communication technology and data management remain recurring problems for a number of technological innovations (Salomonsson, 2018). Humanitarian organisations must enhance their data collection and management processes if they need to profit from the numerous technical advancements and trends that transpire in the ICT sector (Oh, 2022). The insufficient data infrastructure for cases in this analysis has an impact on the viability of deploying the Internet of Things (Salomonsson, 2018).

2.2.2. Information/knowledge sharing

Oh (2022) conducted a study and concluded that the exceptionally high level of heterogeneity inside as well as across groups, organisations, and governmental organisations with regard to experience, size, expertise, and capability is one of the reasons humanitarian players find it challenging to share knowledge and information across organisational borders. Wilson and Jumbert (2018) further add that these distinctions may make it more difficult for different organisations to communicate situational information. The refusal of people, groups, organisations, and government entities to share knowledge and information is another problem (Saastamoinen & Järvelin, 2018).

2.2.3. Informatic challenges

New transnational players and technologically savvy civil society groups are keen to challenge accepted practices and are tiny and nimble (Bryant, 2022). By virtue of their involvement, these individuals provide significant informational obstacles to the co-ordination of humanitarian efforts (Altay & Labonte, 2014). Moreover, the development of information and data clearing houses provides chances for country authorities to establish authority over national agendas, as was the case when the Humanitarian Data Exchange allowed government ministries to monitor the nation's training programmes in infection control and prevention (Wilson & Jumbert, 2018).

2.2.4. Huge investment in electronic data interchange (EDI)

There are expenses associated with employing outside vendors or allocating internal employees to handle IT connections (Aranda et al., 2019). It helps to make the total operating expenses more transparent to establish what is being spent on each item. There is considerable reliance on expensive, bespoke EDI connections that are still peer-to-peer linkages and generate silos, even inside extremely complex supply chain mechanisms (Altay & Labonte, 2014). Direct connections are preferred over time-consuming manual entry or other forms of reports that have to be integrated into the main system when they are not accessible (Maghsoudi & Moshtari, 2020; Rodríguez-Espíndola et al., 2020) (Table 2).

Table 2. Empirically analysing literature on challenges aid entities face when digitalising.

Challenges	Authors	Key points
IT or data management	Salomonsson (2018); Oh (2022)	Insufficient data infrastructure hinders technological deployment in HL operations. There are gaps in ways to enhance data gathering and control for leveraging technological developments.
Information or knowledge sharing	Oh (2022); Wilson and Jumbert (2018); Saastamoinen and Järvelin (2018)	Heterogeneity across organisations and ignorance disturb information communication and sharing. There are gaps in effective mechanisms for sharing situational information, hindering collaborative efforts.
Informatic challenges	Bryant (2022); Altay & Labonte, 2014); Wilson and Jumbert (2018)	New players do create co-ordination challenges, possibly letting authorities control national agendas. Gaps exist in strategies to integrate various entities with no undue control over national agendas.
Huge Investment in EDI	Aranda et al. (2019); Maghsoudi and Moshtari (2020), Rodríguez-Espíndola et al. (2020)	Significant costs related to EDI connections and dependence on expensive, silo-creating systems. There are gaps in exploring efficient alternatives and integrated supply chain solutions.

Source: Authors' postulation (2023).

2.3. The influence of digitalisation on the efficiency of humanitarian aid operations

Digitalisation influences the efficiency of humanitarian logistics operations in various ways which are inexhaustive and include the following:

2.3.1. Communication effectiveness (CME)

Digitalised HL activities have improved information transparency and reliability during the Fourth Industrial Revolution (4IR) due to incessant communication barriers (Preindl et al., 2020). In their study, Wang et al. (2022) found that digital technologies have also changed the global humanitarian aid supply-chain management process, which intelligently gathers and analyses massive real-time data before making decisions and taking action. This revolution improves connectivity and cooperation among all parties involved in HL operations by exchanging information more accurately and in real-time, improving efficiency through reliable decision-making and operational optimisation (Büyüközkan & Göçer, 2018; Wang et al., 2022). Therefore the following hypothesis was developed:

H_1: Increased digitalisation in Zimbabwe's HL operations makes communication better than it has been under conventional set-ups.

2.3.2. Cost reduction (CRD)

Digital humanitarian aid operations provide complete, real-time data on status, performance, and needs. Processes that can benefit from this data include those that deal with raw material movements, inventory levels, operational logistics, resource planning, and forecasting. Digitalised humanitarian logistical operations lead, therefore, to such immediate benefits as improved cash flows and cost reduction (Buss, 2022; Gavalas et al., 2022). The researchers, therefore, developed the following hypothesis:

H_2: Compared to conventional methods, Zimbabwean humanitarian aid operations are much cheaper when they are digitalised.

2.3.3. Automation of humanitarian work processes (AUT)

Humanitarian aid activities that were formerly paper-based and labour-intensive have been substituted with computerised ones (Karadağ, 2022). Humanitarian operations that use technology do away with manual data input and the need for stakeholders to phone or send emails for updates. As a result, all parties have access to all relevant data and are able to enhance their processes independently of one another (Büyüközkan & Göçer, 2018; Karadağ, 2022). As a consequence of digitalisation, business

operations are also automated, increasing worker performance, company productivity, financial soundness, and process efficiency. Therefore, the following hypothesis was developed:

H_3: Zimbabwe's operations are more efficient now that HL processes are automated with digital technologies instead of being done manually on paper.

2.3.4. Sustainability of humanitarian aid operations (SUS)

Many studies have shown that digital technologies can improve humanitarian operations sustainability and that big data analytics capabilities improve firms' economic, social, and environmental performances (Bag, 2017; Dubey et al., 2019; Melo et al., 2019; Mugoni et al., 2023). According to various studies, big data can enhance energy efficiency, cut carbon emissions, and extend product lifespans (Hopkins & Hawking, 2018; Tao et al., 2014; Yang et al., 2021). IoT and big data analytics may reduce the environmental impact of logistical vans (Yang et al., 2021). The following hypothesis, thus, was developed:

H_4: Zimbabwe's aid efforts are more sustainable since digital technologies make them more energy efficient and less harmful to the environment.

2.3.5. Flexibility (FLE)

Flexibility is among the most important features offered by digital technologies that maintain the efficiency of humanitarian aid operations in the face of logistical and supply-chain interruptions (Buss, 2022). Aid organisations are able to remain adaptable when circumstances and demands change globally thanks to technology enabling real-time forecasting and planning. Agile entities with the appropriate technology can withstand the changes and keep humanitarian logistics operations going forward as the environment swiftly changes (Buss, 2022; Büyüközkan & Göçer, 2018). Therefore, the following hypothesis was developed:

H_5: Digitalisation in Zimbabwe's HL operations enhances flexibility, leading to better adaptation to dynamic circumstances compared to traditional methods.

2.3.6. Data-driven innovations from advanced analytics (DDI)

Big data, algorithms, IoT, and data modelling are just a few examples of the data-driven innovations that make it possible for digital humanitarian relief operations (Karadağ, 2022). For improved inventory control and preventative maintenance, such aid entities can link and associate data sources. Companies may use data to discover bottlenecks, enhance product quality, and improve customer service (Buss, 2022; Karadağ, 2022). Below is an empirical analysis of the literature on how digitalisation impacts efficient humanitarian HL operations. Thus, the following hypothesis was developed (Table 3):

H_6: Zimbabwe's digital humanitarian aid operations use advanced data-driven innovations that make product quality, inventory management, and customer service much better than traditional ways.

2.4. The theoretical framework

This study analyses the impact of digitalisation on the efficiency of HL operations in Zimbabwe. The theoretical viewpoints that underpin this are as follows:

2.4.1. The technology-driven efficiency theory

This theory posits that the incorporation and integration of digital technologies within the context of HL operations can augment overall efficacy (Schumann-Bölsche, 2018). The assertion is made that digitalisation facilitates efficient management of supply chains, transportation and fleet operations, information co-ordination, the provision of cash and voucher assistance, and identification and registration of beneficiaries (Oloruntoba, 2018). According to the theory, digital interventions have the potential to enhance communication effectiveness, reduce costs, automate work processes, ensure the sustainability of aid operations, and provide greater flexibility (Schumann-Bölsche, 2018).

Table 3. Empirical literature on how digitalisation predicts efficient humanitarian operations.

Influence of digitalisation	Authors	Some key points
Communication effectiveness	Preindl et al. (2020); Wang et al. (2022)	There is improved reliability and transparency. There is, however, no study exploring the potential disadvantages of incessant connectivity.
Cost reduction	Buss (2022); Gavalas et al. (2022).	Real-time data leads to cost reduction. There are gaps in evaluating unexpected costs during the digital transition.
Automation of processes	Karadağ (2022)	There is a shift to computerised HL operations with, however, some gaps in assessing job displacement as well as potential automation errors.
Sustainability	Bag (2017); Dubey et al. (2019)	Digital technologies enhance sustainability. Gaps, however, are experienced in specific environmental effects within aid operations.
Flexibility	Buss (2022)	The importance of flexibility via digital tools is evident, with some gaps notable in the lack of understanding of vulnerabilities brought about by excessive dependence on technology.
Data-Driven Innovations	Karadağ (2022), Buss (2022)	There are numerous advantages of data-driven innovations. However, some gaps are experienced in evaluating ethical biases and implications in decision-making.

Source: Authors' depiction (2023).

2.4.2. The information systems theory

This theory emphasises how information systems streamline and improve operational processes (Wu et al., 2022). Digitalisation is essential for efficiently managing and using data to make informed decisions and optimise operations (Urbach & Müller, 2012; Wu et al., 2022). Online platforms, big data analytics, and IoT technologies enable aid institutions to collect, evaluate, and use real-time data for improved inventory control, forecasting, and resource planning (Wu et al., 2022). This reduces costs, automates processes, and advances humanitarian logistics with data (Golan & Harte, 2022).

2.5. The conceptual framework

Since the study's main purpose was to analyse how digitalisation contributes to the attainment of efficient humanitarian logistical operations in Zimbabwe, researchers developed the conceptual framework below (Figure 1) as a roadmap for the study, mapping out how variables were related to one another. The conceptual framework is two-dimensional as it is composed of independent and dependent variables (efficient HL operations). Efficient HL operations pertain to the quantitative evaluation of the efficacy and allocation of resources in the provision of assistance throughout humanitarian endeavours. This study measures the efficacy of HL operations across multiple dimensions, including resource allocation timeliness, cost-effectiveness, achievement of aid objectives, and overall process optimisation. Efficient HL operations are, therefore, a continuous variable. Hence, an elevated value on this continuous scale would signify enhanced efficiency, signifying the effective allocation of resources towards the fulfilment of humanitarian goals.

Independent variables include communication effectiveness, cost reduction, humanitarian work process automation, sustainable humanitarian aid operations, and flexibility. The moderating variable of organisation size has the potential to impact the interaction between the predictor variables and the efficiency of humanitarian logistical operations. Larger organisations have greater resources and skills, which enable them to apply digitalisation plans better, hence improving their logistical operations (Dubey et al., 2019). On the other hand, smaller organisations may have difficulties as a result of limited resources, which might hinder the extent to which digitalisation can enhance their operational efficiency (Dubey et al., 2019).

3. Methodology

The study used a positivist philosophy to address the research objectives. The rationale for selecting positivism as the philosophical framework for the study was its adherence to scientific methods, specifically quantitative analysis, which facilitates the methodical examination of digitalisation and logistical

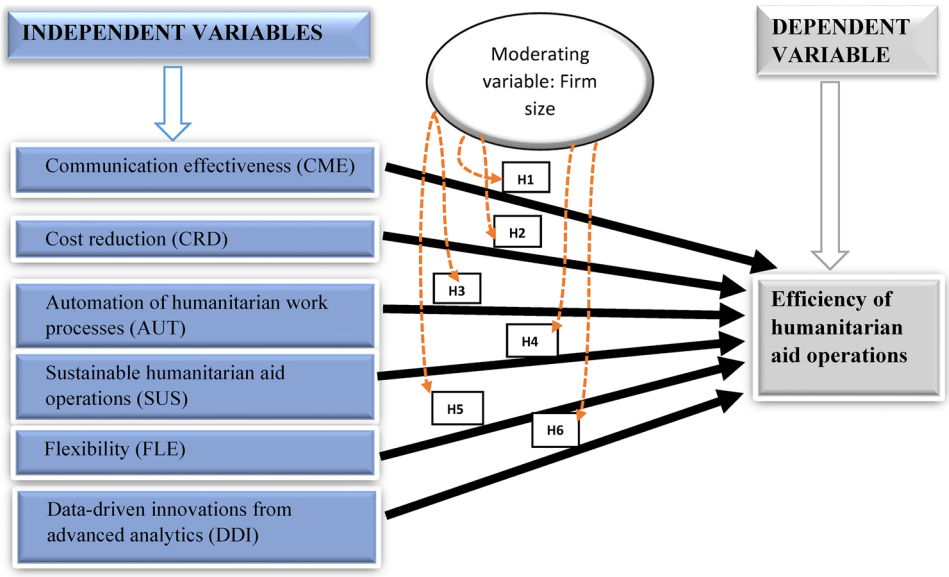


Figure 1. The conceptual framework of the study. *Source*: Authors.

operations. The main objective of adopting a positivist philosophy was to produce research findings that other researchers could replicate and validate (Creswell & Creswell, 2018). This philosophical approach enabled the utilisation of rigorous scientific methodologies to examine the process of digitalisation of humanitarian logistics operations in Zimbabwe. The research design employed in the study was explanatory. The utilisation of an explanatory research design is beneficial as it facilitates the enhancement of comprehension regarding a specific subject matter, the determination of the causative factors of a particular phenomenon, and the projection of future events (Saunders et al., 2019).

Consequently, the study was guided by a deductive research approach. The deductive approach was employed to establish the causal relationship between digitalisation and effective humanitarian logistics operations in Zimbabwe. This approach entailed assessing particular hypotheses developed from prior research against empirical data gathered throughout the investigation (Creswell & Creswell, 2018). Using a deductive approach, the study aimed to contribute to an improved comprehension of the impact of digitalisation on the efficiency of humanitarian aid operations.

The research method diagram for this study is given in Figure 2.

3.1. Population

The study's population included ten selected Aid organisations in Harare (World Food Programme, Oxfam, CARE; Medecins Sans Frontieres, Red Cross; WaterAid; UNICEF; United Nations High Commissioner for Refugees; Internally Displaced Persons, and Catholic Relief Services). The aid organisations were chosen based on their scope of operations and their geographic coverage. The organisations chosen cover a wide range of humanitarian operations, including food aid (World Food Programme), healthcare (Medecins Sans Frontières), water and sanitation (WaterAid), and refugee help (UNHCR), among others. This diversified portrayal is intended to illustrate the multidimensional nature of humanitarian service.

Therefore, the population of the selected ten (10) organisations was 1,000 employees. The sample was derived through Slovin's formula, and the sample size was 286. Stratified sampling was used, whereby the population was broken down into subgroups (each aid organisation was considered a stratum). This ensured that every humanitarian organisation was included in the sample, which is critical for portraying the diversity and subtleties of the many humanitarian organisations. Additionally, simple random sampling was employed inside each stratum to choose a representative sample of participants from each organisation. This method guaranteed that the sample was proportionally representative of the total population while also allowing for a thorough examination of each organisation (Creswell & Creswell, 2018). The sample of the study is shown in Table 4.

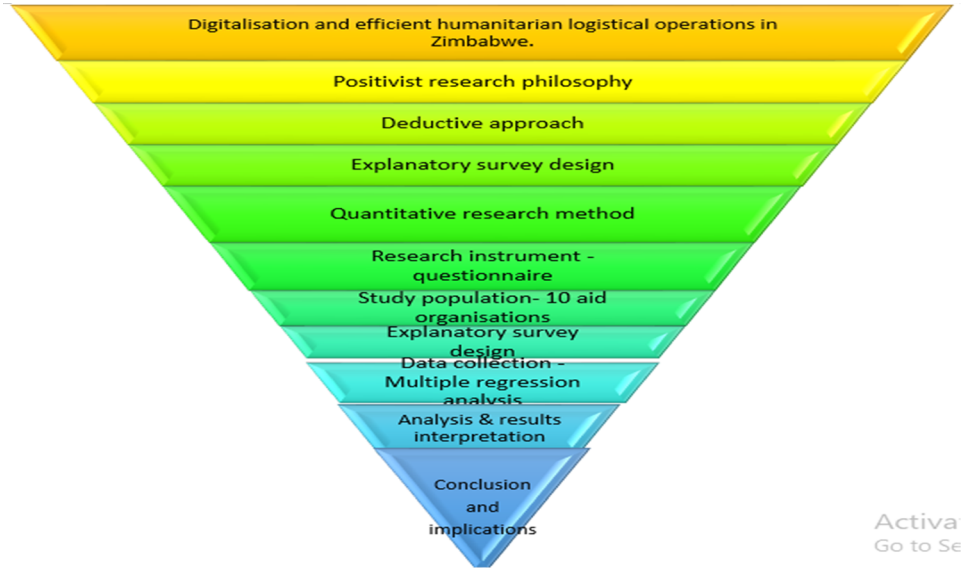


Figure 2. The research method diagram for the study. *Source*: Authors' depiction (2023).

Table 4. Sample of the study.

Organisation	Sample size
World Food Programme	29
Oxfam	29
CARE	29
Medecins Sans Frontieres	29
Red Cross	29
WaterAid	29
UNICEF	29
United Nations High Commissioner for Refugees	29
Internally Displaced Persons	27
Catholic Relief Services	27
Total	286

Source: Authors (2023).

The findings of this Zimbabwean-based research on ten aid organisations could be applied to other countries or regions in SADC or similar situations in Africa based on common obstacles and operational characteristics among humanitarian aid organisations in similar socio-economic as well as geographic environments. Given time and resource constraints, authors could not compare varied SADC or African regions. However, researchers recommended in Section 8 below that future studies should compare humanitarian organisations' infrastructure and cultures. Huge sample sizes and a wider range of aid organisations in varied geographic and socio-economic settings will improve future studies' generalisability outside Zimbabwe.

3.2. Research instrument

Since this study was quantitative, it used a questionnaire as the primary research instrument. According to Saunders et al. (2019), questionnaires offer a systematic and uniform approach to gathering information from a considerable number of respondents. The questionnaire was constructed based on the three (3) research questions of the study referred to in the introduction and background section. The survey used closed-ended questions. Closed-ended questions are designed to elicit responses from respondents that are limited to a preset set of alternatives. This characteristic of closed-ended questions allows for the facilitation of quantitative analysis since the responses can be easily categorised and analysed numerically (Saunders et al., 2019). The questions were formulated based on an extensive examination of the scholarly literature about digitalised humanitarian logistics, humanitarian operations, and the obstacles

encountered by relief organisations. The Likert scale was used to evaluate participants' opinions through a series of questions. The scale ranged from 1 (strongly disagree) to 5 (strongly agree).

The questionnaire (attached as Appendix A) had four sections: Section A (Demographics); Section B (Types of digitalised humanitarian logistical operations); Section C (Challenges encountered by aid entities when digitalising); and Section D (Impact of digitalisation on the efficiency of humanitarian aid operations). The questionnaire constructs was developed based on the previous researches (Bag, 2017; Buss, 2022; Dubey et al., 2019; Gavalas et al., 2022; Karadağ, 2022; Preindl et al., 2020; Wang et al., 2022).

A pilot investigation was undertaken to evaluate the comprehensibility, pertinence, and efficacy of the survey instrument. The process entailed the distribution of the questionnaire to a limited, representative subgroup of the intended population, which was distinct from the primary study sample. The feedback obtained from the pilot research was utilised to enhance and optimise the questionnaire. The questions that were ambiguous or unclear have been revised, and the general flow and structure of the text have been altered.

In order to enhance efficiency and expedite the process of data collection, the questionnaire was distributed electronically. Permission to disseminate the questionnaire to the staff of each assistance organisation was sought by contacting their respective management or authorised contact person. Participants were given explicit information regarding the procedures for both completing and submitting the questionnaire. During the data collection period, researchers were able to reply to any inquiries from the participants.

In order to uphold the instrument's quality, the questionnaire incorporated validation checks, skip patterns, and logical sequences with the aim of minimising mistakes. The clarity and lack of ambiguity in the questions were in line with the study aims, hence minimising the potential for misunderstanding. Furthermore, the response rate for the questionnaire was 86%. The response rate above 80% is regarded as excellent, so the sample size was adequate to generate reliable results (Holtom et al., 2022).

3.3. Data analysis

Through the Statistical Package for the Sciences (SPSS) program, multiple linear regression analysis was used to determine whether digitalisation was a predictor of efficient humanitarian logistical operations in Zimbabwe.

The research hypotheses developed for this study are as follows:

H_1: Increased digitalisation in Zimbabwe's HL operations makes communication better than it has been under conventional set-ups.

H_2: Compared to conventional methods, Zimbabwean humanitarian aid operations are much cheaper when they are digitalised.

H_3: Zimbabwe's operations are more efficient now that HL processes are automated with digital technologies instead of being done manually on paper.

H_4: Zimbabwe's aid efforts are more sustainable since digital technologies make them more energy efficient and less harmful to the environment.

H_5: Digitalisation in Zimbabwe's HL operations enhances flexibility, leading to better adaptation to dynamic circumstances compared to traditional methods.

H_6: Zimbabwe's digital humanitarian aid operations use advanced data-driven innovations that make product quality, inventory management, and customer service much better than traditional ways.

3.4. Ethical considerations

Throughout the study phase, ethical issues were critical. The relevant institutional review board provided ethical authorisation prior to gathering data. Participants were given informed consent papers outlining the study's goal, the voluntary nature of their participation, and the promise of confidentiality. Any

possible risks and advantages connected with participation were discussed openly. All data obtained was anonymised to maintain participant anonymity, and any identifiable information was deleted during the analysis process. Furthermore, the researchers followed ethical guidelines while reporting their findings, presenting them honestly and without deception.

4. Results and discussion

4.1. Respondents characteristics

Table 5 provides an overview of the demographic characteristics of the respondents in this study. Gender shows that 72% were male and 28% were female. It is worth noting that the group of respondents displayed a significant predominance of male individuals. The result is consistent with a previous study conducted by Amushila and Semente (2022), which confirms the existing male predominance within the logistics sector. As for the respondents' experience levels, a significant majority reported possessing 6 to 10 years of professional experience, closely trailed by those with 2 to 5 years of tenure in their respective roles. A smaller faction of respondents indicated having less than two years of experience.

As shown in Table 6, all respondents were educated. Most of the respondents had achieved advanced-level education, followed by those who had degrees and certificates. A minority of the respondents had attained postgraduate education.

4.2. Reliability test

In order to facilitate the examination of the research instrument's reliability, the questionnaire underwent reliability testing using the Cronbach alpha coefficient. The findings of the test are shown in Table 6.

The Cronbach's alpha coefficients, which exceed the threshold of 0.7, indicate that all variables demonstrate a satisfactory level of reliability.

4.3. Descriptive analysis

Based on the descriptive analysis results of various types of digitalised humanitarian logistical operations undertaken by Zimbabwean aid entities, the respondents agreed (mean = 4.35) that their organisations utilised digitalised supply-chain management systems through barcode readers, tracking solutions, inventory management, and distribution processes. The findings are in line with the study by Maghsoudi and Moshtari (2020). Also, the respondents agreed (mean = 4.40) that transport and fleet management operations for their aid organisation were digitalised, and this finding dovetails with what Balci & Surucu-Balci, 2021, established when they discovered that logistic firms are now moving towards digitalisation of their operations. The respondents agreed (mean = 3.78) that digitalised humanitarian aid operations have led to better information management and co-ordination, and the findings are supported by Gitonga and Samson (2022). Furthermore, the respondents agreed (mean = 4.4) that digitalisation has brought about a significant transformation in the provision of cash and voucher assistance within the context of

Table 5. Respondent's characteristics.

Demographic	Description	Percent
Gender	Male	72.0%
	Female	28.0%
Experience	Less than 2 years	3.3%
	2–5 years	34.1%
	6–10 years	52.0%
	10 years and above	10.6%
Education	Ordinary level	17.5%
	Advanced level	20.7%
	Certificate	17.9%
	Diploma	12.6%
	Degree	17.9%
	Postgrad	13.4%

Source: SPSS (Version 27).

Table 6. Reliability test.

Constructs	Questions or scale items	Cronbach alpha
Zimbabwe aid entities undertake various types of digitalised humanitarian logistical operations. (TYP)	TYP1 to TYP5	0.812
Challenges encountered by aid entities when digitalising. (CH)	CH1 to CH5	0.801
Communication effectiveness. (CME)	CME1 to CME3	0.779
Cost reduction. (CRD)	CRD1 to CRD3	0.796
Automation of humanitarian work processes. (AUT)	AUT1 to AUT3	0.825
Sustainable humanitarian aid operations. (SUS)	SUS1 to SUS3	0.763
Flexibility. (FLE)	FLE1 to FLE3	0.787
Organisation size (OS)	OS1 to OS3	0.806
Efficiency of humanitarian aid operations. (EFF)	EFF1 to EFF2	0.818

Source: SPSS version 27 (2023).

humanitarian operations. The respondents also agreed (mean = 4.35) that digital systems are used for the purpose of registering and identifying beneficiaries. The same results were found in the studies by Maghsoudi and Moshtari (2020) and Heymann (2017), who found that digitalisation has brought about a significant transformation when providing financial funds and digital systems are used for the purpose of registering and identifying beneficiaries.

The descriptive statistics also covered the challenges encountered by aid entities when digitalising. The respondents agreed (mean = 4.43) that insufficient data infrastructure remains a recurring problem for the adoption of humanitarian aid operations, and this is in line with the study by Salomonsson (2018). The results of the study found that the respondents agreed (mean = 4.4) that humanitarian aid players find it challenging to share knowledge and information across organisational borders owing to their various sizes and levels of experience, which is consistent with the study conducted by Oh (2022). Also, the respondents disagreed (mean = 1.62) that civil society groups provide significant informational obstacles to the co-ordination of humanitarian efforts as they are many and small. This finding is similar to the studies by Bryant (2022) and Altay and Labonte (2014).

Furthermore, the respondents indicated that they supported (mean = 4.44) the view that huge investment in electronic data interchange is a major deterrent to the digitalisation of humanitarian aid operations, which is in line with the study by Wilson and Jumbert (2018). Lastly, the study found that respondents agreed (mean = 4.36) that the digitalisation of operations by aid entities renders them increasingly susceptible to cybersecurity threats. This finding corresponds with the studies conducted by Altay and Labonte (2014) and Ardaya et al. (2017).

4.4. Multi-collinearity

The majority of the resulting correlations between the variables are positive, ranging from 0.411 to 0.601, and show relatively moderate values below 0.7. Hence, there is no evidence of multi-collinearity between the variables (Creswell & Creswell, 2018) (Table 7).

4.5. Multiple linear regression analysis

The R-squared for the study was 0.748 (74.8%). From this value, it can be interpreted that flexibility, cost reduction, sustainable humanitarian aid operations, automation of humanitarian work processes, and communication effectiveness can explain 74.8% of the variation in efficient humanitarian logistical operations. In addition, the remaining 25.2% of the variation in efficient humanitarian logistical operations can be explained by other factors not included in the study (Table 8).

The model results included the ANOVA test results shown in Table 9.

The analysis of variance (ANOVA) findings indicated a p-value of 0.00, indicating that the model is statistically significant at a 5% level of significance. The study revealed that the independent variables, namely CME, CRD, AUT, SUS, FLE, and OS, are significant predictors of efficient humanitarian logistical operations in Zimbabwe. Furthermore, Table 10 displays the outcomes of the regression coefficients.

Table 7. Multi-collinearity test.

Variable	CME	CRD	AUT	SUS	FLE	OS	EFF
CME	1						
CRD	.482**	1					
AUT	.517**	.459**	1				
SUS	.558**	.462**	.411**	1			
FLE	.495**	.468**	.576**	.538**	1		
OS	.521	.502**	.496**	.587**	.483**	1	
EFF	.603**	.571**	.504**	.498**	.562**	.615**	1

Source: SPSS version 27 (2023).
**indicate correlation coefficiencies that are statistically significant at 0.01 level (significant level of 1%).

Table 8. Model summary[b].

Model	R	R square	Adjusted R square	Std. error of the estimate	Durbin–Watson
1	.865[a]	.748	. 742	.19093	1.765

aPredictors: (Constant), FLE, CRD, SUS, AUT, CME, OS. bDependent Variable: EFF. *Source*: SPSS version 27 (2023).

Table 9. ANOVA.

Model		Sum of Squares	Df	Mean Square	F	Sig
1	Regression	25.874	6	4.312	118.293	.000[b]
	Residual	8.713	239	.036		
	Total	34.587	245			

Source: SPSS version 27 (2023).

Table 10. Regression coefficients.

		Unstandardised coefficients		Standardised coefficients				
	Model	B	Std. error	Beta	T	Sig	Tolerance	VIF
1	(Constant)	.137	.177		1.211	.083		
	CME	.122	.069	.121	1.769	.008	.241	4.126
	CRD	.088	.063	.093	1.394	.016	.240	4.164
	AUT	.221	.064	.232	3.441	.001	.235	4.258
	SUS	.143	.067	.147	2.121	.035	.219	4.560
	FLE	.308	.065	.310	4.705	.125	.227	4.399
	OS	.226	.066	.204	3.539	.006	.201	4.128

Source: SPSS version 27 (2023).

In summary, the research model shows that of the five independent variables, only four (cost reduction, sustainable humanitarian aid operations, automation of humanitarian work processes, and communication effectiveness) had a positive influence on efficient humanitarian logistical operations at a 5% level of significance. The control variable (organisational size) had a positive influence on efficient humanitarian logistical operations at a 5% level of significance. The regression model can be presented as follows:

$$Y = 0.137 + 0.122CME + 0.088CRD + 0.221AUT + 0.143SUS + 0.226OS + e$$

Table 11 is a summary of outcomes from the hypotheses tested.

4.6. Discussion of results

The results showed that cost reduction, sustainable humanitarian aid operations, automation of humanitarian work processes, communication effectiveness, and organisational size had a positive relationship with efficient humanitarian logistical operations. These results are consistent with previous studies showing a positive influence of communication effectiveness (Wang et al., 2022); cost reduction (Schumann-Bölsche, 2018); automation of humanitarian work processes (Karada, 2022); sustainable humanitarian aid operations (Melo et al., 2019); and organisational size (Dubey et al., 2019) on enhancing efficiency within HL operations.

Table 11. Hypothesis test results.

Hypothesis	Results	Conclusion
Increased digitalisation in Zimbabwe's HL operations makes communication better than it has been under conventional set-ups.	Reject H_0	Results support hypothesis
Compared to conventional methods, Zimbabwean humanitarian aid operations are much cheaper when they are digitalised.	Reject H_0	Results support hypothesis
Zimbabwe's operations are more efficient now that HL processes are automated with digital technologies instead of being done manually on paper.	Reject H_0	Results support hypothesis
Zimbabwe's aid efforts are more sustainable since digital technologies make them more energy efficient and less harmful to the environment.	Reject H_0	Results support hypothesis
Digitalisation in Zimbabwe's HL operations enhances flexibility, leading to better adaptation to dynamic circumstances compared to traditional methods.	Do not Reject H_0	Results do not support the hypothesis.

Sources: Authors' depiction (2023).

The study's theoretical perspectives align with research findings, suggesting digitalisation in HL operations can improve effectiveness by streamlining supply chain management, transportation, and fleet operations (Oloruntoba, 2018). Digital interventions improve communication, reduce costs, automate processes, promote sustainability, and provide greater flexibility (Schumann-Bölsche, 2018). The study utilises a theoretical framework that combines technology-driven efficiency theory and information systems theory, which is in perfect agreement with the research findings. The technology-driven efficiency theory, as posited by Schumann-Bölsche (2018) suggests that digital technologies improve the overall effectiveness of HL operations. The results support this hypothesis by showing positive correlations between digitalisation elements (CME, CRD, AUT, SUS, and FLE) and efficient HL operations.

Furthermore, the information systems theory highlights the significance of digitalisation in improving operational procedures by utilising data through sophisticated technologies such as online platforms, big data analytics, and the Internet of Things (IoT) (Urbach & Müller, 2012; Wu et al., 2022). The use of digital tools in this context allows for the real-time utilisation of data in order to enhance inventory control, forecasting, and resource planning. This ultimately leads to cost reduction and enhanced operations in the field of humanitarian logistics (Golan & Harte, 2022).

In a nut-shell, this study's results not only validate the positive impact of digitalisation on several aspects of HL operations but also emphasise the importance of organisational size as a contributing element. These findings add to the expanding collection of research on digital aid operations, offering useful insights for policymakers and practitioners to improve the effectiveness and long-term viability of humanitarian initiatives in Zimbabwe.

4.6.1. Significance of the study

The study's findings about the positive relationships between digitalisation elements and effective humanitarian logistics in Zimbabwe have practical implications. Aid organisations have the opportunity to utilise this evidence in order to improve operational efficiency, save costs, and foster sustainability by implementing well-informed digitalisation initiatives. The results of this study enhance the current understanding of the beneficial effects of digitalisation on humanitarian logistics, with a particular emphasis on its contextual significance within the Zimbabwean setting. This study provides significant insights for assistance organisations, particularly in resource-constrained settings, to enhance decision-making and optimise the effectiveness of digital technology in the delivery of humanitarian help.

4.6.2. Contribution of the study

This work makes substantial contributions to the field of humanitarian logistics and digitalisation through several means. The congruence between theoretical frameworks and empirical evidence contributes to the advancement of knowledge regarding the impact of digitalisation on the efficacy of humanitarian

logistics. This alignment serves to strengthen our comprehension of the subject matter and further develop current theoretical constructs. The research's primary emphasis on Zimbabwe offers culturally relevant findings, recognising the variations in the implications of digitalisation across different areas and economies. This underscores the significance of doing research that is specific to local contexts. The identification of communication efficacy, cost reduction, automation, sustainability, and organisational size as crucial variables highlight their importance within technology adoption frameworks for humanitarian relief organisations. This identification provides a practical framework for organisations aiming to utilise digitalisation as a means to enhance operational efficiency. Furthermore, through the emphasis on favourable associations, the research provides practical approaches for augmenting operational efficacy in the realm of humanitarian logistics. This offers organisations specific areas of focus for the creation and execution of digital interventions, ultimately leading to enhancements in their overall effectiveness.

5. Managerial and theoretical implications

The results of this study have significant consequences for both the management tactics and theoretical foundations of humanitarian assistance operations in Zimbabwe. From a management standpoint, the study emphasises the utmost significance of adopting digital technology to improve the effectiveness of humanitarian relief operations. Aid organisations in Zimbabwe should create detailed strategies for digital modernization, dedicating resources to crucial technologies like supply chain management solutions and barcode readers. Moreover, it is considered crucial to allocate a specific budget for the development of strong digital infrastructure, the implementation of cybersecurity measures, and the utilisation of collaboration tools in order to effectively address the difficulties related to digitalization and protect against cyber risks.

In order to effectively address these difficulties, managers are recommended to give priority to the dissemination of information inside their organisations and forge strategic alliances with technological firms. This cooperative methodology not only tackles the present difficulties but also cultivates a mindset of ongoing education and adjustment, which is essential for the long-term prosperity of digitally-powered humanitarian assistance endeavours.

The study has important theoretical implications as it adds to previous ideas by offering actual evidence of causal correlations between key components of digitalization and the effectiveness of humanitarian logistics. The study is in line with theories of information systems, highlighting the crucial significance of digitalization in enhancing supply chain management and resource planning by using data. The study enhances current ideas by demonstrating these cause-and-effect links, thus offering a deeper comprehension of the complex dynamics between digital technology and operational efficiency.

Furthermore, the study's recognition of distinct impacts within the Zimbabwean context, while still relevant to comparable circumstances in the area, establishes it as a significant resource for future investigations into assistance programmes and cultural subtleties in various African regions. The study's focus on a specific location strengthens its contribution to the wider academic discussion on the digitalization of humanitarian relief. It emphasises the need to consider the specific situation while developing theories and implementing practical tactics. In summary, this study acts as a catalyst for making strategic decisions in managing humanitarian aid and enhances the theoretical understanding of how digital technologies affect operational efficiency in the humanitarian sector.

6. Conclusions

The conclusive findings demonstrate that Zimbabwean HL firms have widely embraced digitalised supply-chain management systems, utilising technology such as barcode scanners and tracking solutions. Despite the evident benefits, aid entities encounter challenges such as information-sharing barriers, substantial investments in electronic data interchange (EDI), and cybersecurity threats during the process of digitalisation. The study is in line with industry standards as the digitalisation of transport and fleet management activities reflects the current trends in the logistics sector. Significantly, digitalisation serves as a catalyst for improving the efficiency of HL operations, resulting in favourable effects on communication effectiveness, cost savings, process automation, sustainability, and efficient information

management. These results support the need for thorough digital plans and collaborative techniques in management, while also validating the causal linkages shown in previous academic studies.

7. Limitations of the study

The fact that the study focused on Zimbabwean aid organisations makes it difficult to know if the results can be used in other situations. To get around this problem, future studies could look at a wider range of regions and humanitarian organisations. This would help us learn more about how digitalisation affects HL in different settings. Response bias could happen if survey results were based on what people say about themselves. To deal with this, researchers suggested the use of mixed-methods approaches, which combine survey data with objective metrics or qualitative insights to give a more complete and unbiased picture of the topic. The cross-sectional design makes it hard to figure out which factors of digitalisation lead to better operational efficiency. Using a longitudinal study design would make it possible to track changes over time, making it easier to conclude cause and effect. Even though efforts were made to deal with multi-collinearity, the research may not fully show how variables interact in real life. Using advanced statistical methods like structural equation modelling could help figure out the complicated relationships between digitalisation factors and how they affect operational efficiency. This would give a deeper understanding of the mechanisms at work.

8. Suggestions for future studies

A longitudinal survey could help us understand how digitalisation has changed things over time. Comparing studies in different regions or countries would make it possible to see how well the results could be used in other places. Qualitative studies could help us learn more about the human and organisational factors that affect how well digital solutions are adopted and put into place. Also, looking into the moral and social effects of digitalisation in aid operations could show how efficiency and other humanitarian values might have to be traded off.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendix A: Questionnaire

Section A: Respondents' general details

1. Your gender (please tick).

Gender
Male
Female

2. Your years of experience (please tick).

Years of experience
Less than 2
2–5
6–10
10 and above

3. Your highest educational achievement (please tick).

Educational level
Ordinary level
Advanced level
Certificate
Diploma
Degree
Postgrad

NB: Sections B to D below utilised a 5-point Likert scale whose ratings are given below: [1—Strongly Disagree; 2—Disagree; 3—Neutral; 4—Agree; and 6—Strongly Agree]

	Section B: Various types of digitised humanitarian logistical operations undertaken by Zimbabwe aid entities	1	2	3	4	5
TYP1	Our organisation utilises digitised supply-chain management systems through barcode readers, tracking solutions, inventory management, and distribution processes					
TYP2	The transport and fleet management operations for our aid organisation are digitised					
TYP3	Digitised humanitarian aid operations have led to information management and coordination					
TYP4	Digitisation has brought about a significant transformation in the provision of cash and voucher assistance within the context of humanitarian operations					
TYP5	Digital systems are utilised for the purpose of registering and identifying beneficiaries					
	Section C: Challenges encountered by aid entities when digitizing	1	2	3	4	5
CH1	Insufficient data infrastructure remains a recurring problem for the adoption of humanitarian aid operations					

	Section B: Various types of digitised humanitarian logistical operations undertaken by Zimbabwe aid entities	1	2	3	4	5
CH2	Humanitarian aid players find it challenging to share knowledge/ information across organisational borders owing to their various sizes and levels of experience.					
CH3	Civil society groups provide significant informational obstacles to the co-ordination of humanitarian efforts as they are many and small					
CH4	Huge investment in EDI is a major deterrent to the digitisation of humanitarian aid operations.					
CH5	The digitisation of operations by aid entities renders them increasingly susceptible to cybersecurity threats					
	Section D: Digitisation as a predictor of the efficiency of humanitarian aid operations in Zimbabwe	1	2	3	4	5
CMM	Communication effectiveness					
CME1	The supply-chain management process is, through effective communication, undergoing significant changes.					
CME2	By exchanging information more correctly and also in real-time, connectivity and cooperation among humanitarian logistical partners are enhanced					
CME3	Effective communication improves the efficiency of HL operations through accurate decision-making and operational optimisation					
CRD	Cost reduction					
CRD1	Digital humanitarian aid operations provide complete, real-time and cheaper data on status, performance, and needs					
CRD2	Processes which gain from real-time data include those dealing with raw material movements, inventory levels, operational logistics, resource planning and forecasting					
CRD3	Digitised HL operations lead to immediate benefits such as improved cash-flows and cost reduction.					
AUT	Automation of humanitarian work processes					
AUT1	Automated business operations increase worker performance and company productivity					
AUT2	Digitised HL operations lead to automation which also results in improved financial soundness					
AUT3	Resultant automated work processes have the impact of improving process efficiency					
SUS	Sustainable humanitarian aid operations					
SUS1	Digital technologies may be utilised to enhance humanitarian operation sustainability					
SUS2	The capabilities of big data analytics have a significant positive influence on aid firms' performance					
SUS3	Big data may be utilised to improve energy efficiency, to lower carbon emissions, and to extend product lifespans					
FLE	Flexibility					
FLE1	Flexibility maintains the efficiency of humanitarian aid operations in the face of logistical/supply-chain interruptions					
FLE2	Aid organisations are able to remain adaptable when change occurs globally due to real-time forecasting and planning					
FLE3	Agile entities can withstand the changes and keep HL operations going forward as the environment swiftly changes					

Appendix B: Kmo and Bartlett's test of sphericity

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.457
Bartlett's Test of Sphericity	Approx. Chi-Square	2312.222
	df	210
	Sig.	.000

Source: SPSS version 27 (2023).

Appendix C: Total variance explained (eigenvalues)

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.729	12.994	12.994	2.729	12.994	12.994	1.810	8.619	8.619
2	2.219	10.565	23.559	2.219	10.565	23.559	1.795	8.548	17.167
3	1.993	9.490	33.049	1.993	9.490	33.049	1.792	8.534	25.701
4	1.754	8.354	41.402	1.754	8.354	41.402	1.770	8.431	34.132
5	1.680	8.000	49.403	1.680	8.000	49.403	1.753	8.345	42.477
6	1.618	7.703	57.106	1.618	7.703	57.106	1.744	8.306	50.783
7	1.569	7.472	64.578	1.569	7.472	64.578	1.733	8.251	59.034
8	1.330	6.331	70.909	1.330	6.331	70.909	1.726	8.221	67.255
9	1.245	5.930	76.838	1.245	5.930	76.838	1.050	4.999	72.253
10	1.078	5.133	81.971	1.078	5.133	81.971	1.017	4.844	77.097
11	.975	4.642	86.614	.975	4.642	86.614	1.015	4.835	81.933
12	.769	3.664	90.277	.769	3.664	90.277	1.003	4.774	86.707
13	.587	2.793	93.070	.587	2.793	93.070	1.001	4.767	91.474
14	.280	1.331	94.401	.280	1.331	94.401	.345	1.644	93.118
15	.249	1.185	95.586	.249	1.185	95.586	.295	1.403	94.520
16	.205	.975	96.561	.205	.975	96.561	.283	1.346	95.866
17	.178	.850	97.410	.178	.850	97.410	.247	1.175	97.041
18	.162	.772	98.183	.162	.772	98.183	.240	1.141	98.183
19	.150	.717	98.899						
20	.124	.592	99.492						
21	.107	.508	100.000						

Extraction Method: Principal Component Analysis.

Source: SPSS version 27 (2023).