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A Model for Understanding the Mediating Association of Transparency between Emerging Technologies and Humanitarian Logistics Sustainability

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Citation: Khan, M.; Parvaiz, G.S.; Ali, A.; Jehangir, M.; Hassan, N.; Bae, J. A Model for Understanding the Mediating Association of Transparency between Emerging Technologies and Humanitarian Logistics Sustainability. *Sustainability* **2022**, *14*, 6917. <https://doi.org/10.3390/su14116917>

Academic Editors: QiuHong Zhao, Chengfeng Wu, Yanhong Ma and Dongmei Ni

Received: 27 March 2022

Accepted: 30 May 2022

Published: 6 June 2022

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Abstract: There has been considerable worldwide attention to the Internet of Things (IoT), blockchain technology (BCT), and artificial intelligence (AI) in all sectors of the economy. Despite still being in the expansion phase, the application of the IoT, BCT, and AI to humanitarian logistics (HL) has drawn a lot of interest due to their significant success in other industries. Commercial and noncommercial organizations are both under growing universal pressure for transparency. Therefore, this study offers a model for understanding the mediating association of transparency between emerging technologies and HL sustainability. The partial least squares structural equation modeling (PLS-SEM) approach was used in conjunction with SmartPLS3. The software was applied to information acquired via questionnaires from 434 disaster relief workers (DRWs) chosen using the snowball sampling approach. The findings suggest that in disaster relief operations (DROs), where corruption and mismanagement in HL have been key concerns for all stakeholders, emerging technologies could be a way forward to achieving system transparency and HL sustainability. The ultimate beneficiaries of transparent and sustainable HL will be all of society, especially the victims of catastrophes. Such victims can receive proper aid on time if the appropriate technology is used in DROs, and early warnings can save many lives. This study adds to the body of knowledge by providing the first empirical evidence assessing the role of emerging technologies in HL transparency and sustainability.

Keywords: humanitarian logistics (HL); Internet of Things (IoT); blockchain technology (BCT); artificial intelligence (AI); transparency; disaster relief operations (DRO); sustainability

1. Introduction

Due to the increasing intensity and frequency of both natural and manmade disasters, the consequent human suffering has increased. Between 1998 and 2017, natural disasters killed almost 1.3 million people, affected more than 4.4 billion people, and caused economic losses of about US \$2908 billion. In addition, in 2018, there were 315 disaster events recorded worldwide, 11,804 deaths, and more than 68 million persons affected, with lost assets at almost US \$131.7 billion. Moreover, the unexpected COVID-19 pandemic that began in 2020 and its tremendous global economic and healthcare impact triggered humanitarian problems in many parts of the world [1,2]. On a regional basis, Asia was the continent most affected in the world [3].

On the Asian continent, Pakistan regularly faces both types of catastrophes. Since its sovereignty, besides wars with India, Pakistan has lost almost 56 million people in the war

against terrorism. From 2000 to 2018, Pakistan placed fourth on the list of countries affected by catastrophes, losing 73,338 persons in 15 earthquakes [4]. In the 2010 flood in Pakistan, asset losses totaled around 5.8% of the country's GDP, with 20 million people affected [5]. Moreover, from 1971 to 2001, 14 cyclones made landfall along the coastal region of Pakistan. Besides flooding, Pakistan is situated on a 528-mile-long geological fault line, and many earthquakes between 1935 and 2015 have occurred [5]; there were 280 casualties in the 2015 earthquake that affected almost 1.5 million people [6].

When assistance is a matter of life or death, some individuals are only interested in money, and are not interested in assisting the afflicted. Moreover, humanitarian organizations (HOs) want to assist victims, but demonstrate unwillingness for multiple reasons, such as demands for bribes and other forms of corruption [7]. Case studies have demonstrated corruption and a lack of transparency in both developing and developed countries. Examples include the Philippines in 2013, the Haiti earthquake [8], the 2010 flood in Pakistan, the 2008 Wenchuan earthquake in China, the Indian Ocean tsunami in 2004, the sex-for-food scandal in 2002 in West Africa, Hurricane Katrina, the 2015 Nepal earthquake, and wars in Afghanistan, Iraq [9], and Nepal.

Such case studies presented evidence of unfair aid distribution, incompetence, political and local individual interference, and corruption, which bring unsustainable humanitarian logistics (HL). Other factors that influence people's suffering after a disaster are uneven distribution of relief resources from not using emerging technology and from a lack of transparency. Now the need to incorporate technology in HL is recognized. While transparency in the supply chain (SC) in general is well-explored in the literature [10–12], transparency in the context of HL is a relatively less explored research area [13–18]. Similarly, research on the Internet of Things (IoT), blockchain technology (BCT), and artificial intelligence (AI) in HL has a strong footing in the contemporary literature; nevertheless, the IoT, BCT, and AI in relief operations have recently attracted the attention of scholars [15,18–23]. However, the humanitarian context is an under-researched area that invites further investigation, especially from the sustainability perspective.

Most of the existing research addressed either variables concerning technology [24] or transparency [17] in HL. Only a handful of studies, such as ref. [23] and ref. [18], have examined the IoT, BCT, AI, and transparency together in the HL context. However, no approach is found in this field for the adoption of the IoT, BCT, and AI to make HL transparent and sustainable. Donors have increasingly called for greater transparency in HL, especially during the COVID-19 crisis [25]. Transparency shows the intent of HOs is to determine honest and appropriate principles associated with the sharing of information, which reveals the integrity of the organizations in generating trust and improving performance [26]. On the other hand, unclear and unreliable information in HL is mainly considered the key hurdle for co-ordination and, ultimately, for sustainability [27]. Similarly, sustainability is a new and less clear theme in humanitarianism. Nevertheless, sustainability recognition is crucial, and is an area of interest for scholars and practitioners. In HL, the key goals from sustainability are linked to saving lives, decreasing human suffering, and contributing to the developmental stage of the disaster [28]. Likewise, in the business context, stakeholders are increasingly pressuring businesses to adopt sustainable methods [29,30]. Sustainable behavior contributes to a company's returns by increasing revenue and improving staff productivity, as well as reducing energy and water waste, resource expenses, employee turnover, and threats [31], as well as reducing unpredictability in stock values and financial returns as a result of market value and customer dissatisfaction. Furthermore, unsustainable behavior leads to greater risks and more unsatisfied customers [30]. Accordingly, we recognize this research gap and pose the following study question. What are the impacts of the IoT, BCT, and AI on the components of sustainability (effective inventory management, robust information, and effective donation management) in HL that are mediated by transparency?

Consequently, the objective of the present study is to offer a picture of the demand for HL transparency and sustainability, and to determine how they should be accomplished. In

addition, the state of the current body of knowledge on technology and transparency does not completely indicate how the construct can be hypothesized, how the IoT, BCT, and AI are associated with governing transparency in organizations, or how organizations operate in the IoT with BCT and AI in terms of HL. Therefore, this study has three objectives. The first is to look at how the impact of the IoT, BCT, and AI on transparency in the HL context has been studied in a variety of academic domains. The second is to examine the influence of transparency on the components of sustainability in HL. Third is to investigate the significance of transparency as a mediator between HL sustainability and the IoT, BCT, and AI. To achieve these objectives, partial least squares structural equation modeling (PLS-SEM) was applied with SmartPLS v3.3.6. This research develops research hypotheses, and statistically tests the conceptual framework on data collected using questionnaires from DRWs in various HOs operating across Pakistan. On the basis of these findings, this research highlights theoretical, practical, and social implications.

The paper is organized as follows. A literature review of study variables is presented in Section 2. Section 3 presents the research model and hypothesis development. The methods applied in the research are detailed in Section 4. In Section 5, data assessment and empirical results are described. Section 6 focuses on discussion, followed by the conclusion to this research.

2. Literature Review

2.1. Humanitarian Logistics

Unfortunately, disaster relief will remain an enlarging market; it is predicted that in the next 50 years, calamities may increase at five times the present rate. Subsequently, delivery and distribution of relief items may become an important worldwide industry [32]. In the last few decades, a great number of both man-made and natural disasters have stricken numerous localities worldwide. Consequently, a large number of victims remain, and there is long-term harm to the areas concerned. In order to sustain effective operations in the affected areas, and to meet the fundamental needs of survivors, it is imperative to focus on the proper distribution of relief items through proper planning and execution, and obtain valuable information about the affected areas [33].

For this process, HL is the technical term for the procurement, transportation, and storage of materials flowing from their origin to disaster-prone areas, including last-mile distribution. After any disaster strikes, effective HL plays an imperative role in the DRO [33]. HOs, on the other hand, have not recognized or articulated this reality [34]. As a result, despite a process that can lead to the success or failure of a relief operation [17,35–38], HL receives the least attention inside HOs. Around 80% of the relief operation's expenses and contributions come from HL [35]. HL is an umbrella term that covers a wide spectrum of the DRO, and safeguards both the response and development stages of a disaster [32]. HL serves as a link between the mitigation and response phases of a disaster, as well as between supply and procurement in the field and the operations center. Following a disaster, a balance should be struck between speed, accuracy, and cost in terms of product type, quantity, and availability [39].

Sustainability is understood from its social, financial, and ecological aspects. The 2030 Agenda for Sustainable Development plays an active role in a region when it is imperative for humans. Leaders worldwide agreed on the approach to utilize the resources and to develop the world [40]. Sustainability is a completely modern and a less explained course in the HL context. Nevertheless, sustainability knowledge is important and is an issue of interest to scholars and professionals.

HOS focus on sustainability mainly from the viewpoint of contextual prospects for society as well as for the beneficiaries. Most of the expectations on humanitarianism performance can also be known as sustainability expectations. Saving lives and alleviating human suffering align with social responsibility, whereas contributing to advancement corresponds to the longer term aims of sustainability, particularly when combined with ecological components of sustainability [28]. Sustainability in the humanitarian field is

sustaining operations or, more specifically, “being able to survive as a result that it may persist to serve its region” [41]. The United Nations defined sustainability as meeting current requirements without sacrificing the ability of upcoming generations to meet their own needs [42]. Sustainability is also defined as “determining whether an activity or effect is likely to persist after donor support has been discontinued” [43]. The definition emphasis is the long-term (social) influence of humanitarian interventions. This suggests a deeply ingrained overarching attitude that encompasses a wide range of sustainability goals.

Therefore, the primary goal of sustainability in HL is to preserve lives, alleviate suffering, and contribute to the redevelopment of disaster-affected populations. Likewise, in for-profit organizations, stakeholders are progressively pressuring the organization to implement a sustainability method [29,30,44–47]. Sustainable behavior increases an organization’s returns by increasing revenue and employee productivity, lowering energy and water waste, reducing resource expenditures, employee turnover, and hazards [31], and decreasing stock price volatility through positive economic returns from market value and customer satisfaction. Furthermore, a lack of long-term behavior increases risk and lowers consumer satisfaction [30]. The key difference between businesses making profits and HOs working to save lives is that the latter decreases human suffering and helps in the redevelopment of the people after a disaster strikes [42]. All the goals of HOs are associated with sustainability. As a result, it can be stated that HL sustainability is no longer an option, but a necessity. Rather than being a burden, sustainability is essential for saving lives, reducing human suffering, and for redevelopment after a disaster. In this regard, transparency and technology is hence realized as the key activity for sustainability.

2.2. Transparency in HL Sustainability

All local and international HOs want to help disaster victims, but they cannot do so for several reasons. There are inefficient governments, bad governance, political influence, and local people involvement [17]. Moreover, a shortage of resources, different kinds of corruption, nepotism, and favoritism are also hurdles on the way to sustainable HL [9]. Similarly, falsified expense reports, kickbacks, sexual abuse, appointments without merit, and forcing or threatening DRWs or relief recipients for social or personal and/or political gain can occur. In addition, favoring one group in particular, covering nontarget groups, and receipt falsification are major obstacles to an effective HL process [9]. Corruption in transportation consists of unauthorized personal use, siphoning fuel, collusion with fuel providers, falsifying records, unnecessary repairs, and overcharging for repairs, and are noted in the HL process [9].

Fund shortages and competition for funds raise the importance of transparent HL [48]. There is no specific and approved definition of transparency, because the concept is broad. However, transparency has been defined as reliable and timely economic- and social-information sharing by an organization via the best possible channel, accurately and clearly, with all relevant stakeholders for the purpose of proper decision making and feedback to secure the process [49]. Transparency is not only the sharing of goods outside the organization but sharing what is true and where improvements can occur [50]. Research on transparency also advocates for the positive effects of transparency on the SC. Sodhi and Tang [12], for example, identified numerous benefits from transparency in business logistics. Likewise, the vitalness of transparency and its role in sustainable SC has been emphasized [11]. Chen et al. [10] examined the impact of SC transparency on sustainability under nongovernmental organization scrutiny. However, the findings can be applied to HL. Transparency in HL is a global issue for all HOs, all of society, all governments, all victims, and for the general public. Transparency equally attracts the attention of researchers, who then examine the causes and indicate the remedies for improving transparency in HL. Apart from scholars, international organizations firmly believe that the effectiveness of HL primarily depends on transparency. In this regard, these organizations have provided detailed guidelines on HL transparency. Some researchers have also emphasized the

importance of transparency in the humanitarian sector [17,18]. These studies provided a strong foundation for the role of transparency in the HL process.

Transparency in logistics leads to improvements in organizational capital, effective inventory and donation management, and robust information [51]. Generally, both commercial and noncommercial organizations are under growing pressure for transparency. Donors are the imperative stakeholders with the most power in a DRO [52]. These donors are ambitious in their key purpose of giving resources to HOs to decrease disaster risks. If the use of the donations is not up to the mark in any organization, they can stop providing resources. Donors wish for the utmost transparency and visibility [38]. Proper supply of resources is a sign of sustainable HL [53,54]. Sustainable HL will not merely reduce risks, costs, and timelines, but will also save people's lives and decrease suffering. Thus, HL should be fast, fair, and safe, which is only possible through the use of emerging technologies. Authentic leadership and organizational transparency are the driving forces of internal transparency, which attracts financial resources, creates strategic value, and promotes economic sustainability through volunteer collaborations and efficiency in an organization [55]. Advanced technology has demonstrated the levels of transparency in any organization [56]. The study model in [35] demonstrated that the root cause for a lack of transparency is not applying technology to HL.

2.3. Technology for Transparency in HL

Technology has been a major enabler in business operations for a long time [57]. There are three main building blocks of technology: information generation, handling, and usage [58]. The first concept refers to gathering information for enhancing transparency; information handling is managing and analyzing it, whereas information usage is planning and executing tasks and analyzing them. A global review of the catastrophe programs of the United Nations stated that the application of information, technology, and practical studies may be the key to handling a DRO. Therefore, a lot of effort has commenced for applying information and technology during disasters. These days, technology linkages to Industry 4.0 has been observed as a possible key to the challenges confronted by HL [24].

Scholars and practitioners recommend the adoption of digital solutions to track the flow of donations and resources from source to destination, and to detect flows in the system to ensure transparency in DROs [59]. The challenges concerning visibility in HL are worldwide, because corruption is evident around the world. The development of technology and its ability to offer proper solutions has enhanced the trust of HOs that use digital solutions to help ensure proper supplies arrive on time [18]. Emerging technologies are considered the most important factor in regulating the success and/or failure of relief operations as set out by management [60]. Regional actors and authorities require appropriate information to develop reliable disaster scenarios in order to make better strategic decisions [61]. In recent years, HOs and government agencies have adopted blockchain technology, which makes logistics tamper-proof and highly transparent [62]. In addition, technology can significantly improve the decision-making process in a DRO [60].

In Pakistan, technology in HL is a challenging task for numerous reasons. The volunteers and government officials engaged in HL and DROs are not technically adept at supporting and adopting technology in humanitarian work. Overall, HL faces a significant shortage of experts [63]. Moreover, an overall weak transparency structure and a culture of bribery and corruption require stringent controls and robust solutions [64]. In addition, the adoption and implementation of technology to observe transparency in HL require substantial financial resources to hire experts and develop the information systems that can help track the movement of resources in DROs [60]. Limited financial resources is the main barrier to the adoption of technology in HL in Pakistan [36]. Many scholars have examined technology in the context of DROs [24,35,36,65]. AI, BC, and the IoT are the technologies determining future growth in relief operations [66], and they offer appropriate technologies for data management and application [58]. Technologies such as the IoT, BCT, and AI can be progressively used in the upcoming era [67]. AI and the IoT have been successfully

combined with BCT [68,69]. Therefore, this article focuses on the combined effect, use, application, and roles of the IoT, BCT, and AI for transparent and sustainable HL.

Thus, it is evident that despite having literature support, the impact of technology and transparency on HL has not been empirically examined yet, which invites researchers to provide empirical evidence for the claims. Based on strong literature support, this research therefore studies the relationship between these two variables in the geographic context of Pakistan.

3. The Research Model and Hypothesis Development

Technology and transparency in the commercial SC have gained firm ground and are well explored from various perspectives. Recent studies are relevant and purely focused on technology and transparency in the humanitarian context [13,15–18,23]. Among them, Khan et al. [23] examined the application of the IoT and BCT. However, in that study, the role of transparency was examined with regard to public trust. Similarly, the authors in [18] investigated the role of transparency in HL where technology was a moderator. In another study, facets of transparency were variables mediated by public trust as used for effective HL, but technology was completely ignored [17]. All these studies highlighted the role of transparency in HL, and the relationship between emerging technologies (the IoT, BCT, and AI) with HL facets of sustainability as variables. Effective inventory management, robust information, and effective donation management mediated by transparency were not empirically measured.

Based on the critical review of the literature presented in the previous section, we developed this study's research framework, as shown in Figure 1. In the research model, technology as an independent variable constitutes three facets: the IoT, BCT, and AI. HL sustainability as a dependent variable constitutes three components: effective inventory management, robust information, and effective donation management. Transparency serves as a mediator that influences the relationship between sustainability and HL. The hypothesis development is presented in the following subsections.

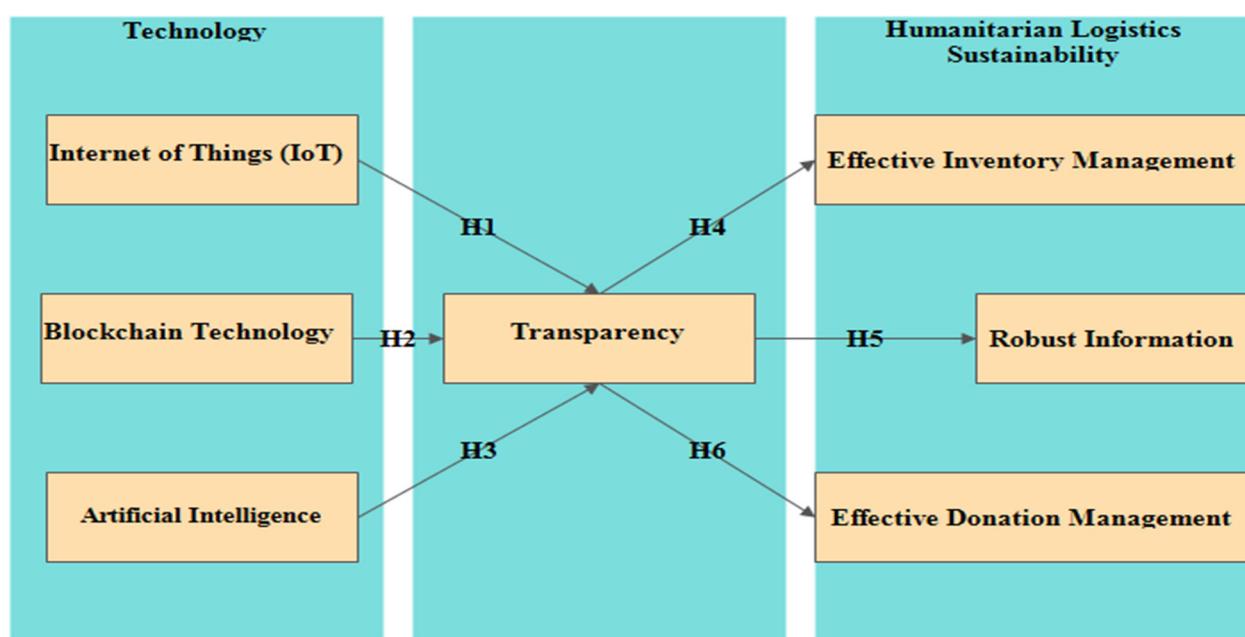


Figure 1. The research model.

3.1. The Internet of Things and Transparency

The IoT is a current universal internet-grounded data planning method for universal computing. It facilitates materials and services exchange procedures, empowering smart circumstances to detect objects and recover data from the internet to assist their adaptive

functioning [23]. The IoT allows various devices to remain permanently connected and share reports [70], and it reduces risks through device interconnection [71]. Computers, smartphones, and remote controls are examples of IoT devices with security issues [72]. Smart contract self-executing programs assist in tracing and tracking distributions by gathering pertinent data from sensors (IoT-enabled devices) or input from organizations [73].

By maintaining a constant ledger of transactions accessible to all actors involved in DROs, the IoT opens up a wide range of opportunities for correcting erroneous operations. Furthermore, the IoT has the potential to connect several devices to a network and transfer data without interruption [19,70]. As a result, consistent communication with the environment is established in order to overcome a variety of variables while lowering risks and limiting potential nonconformities. Furthermore, because the IoT allows for public availability of information, all HL operations are monitored and managed following norms and regulations [19]. As a result, the IoT has the potential to increase transparency, and plays the following role.

H1: *The Internet of Things is strongly linked to transparency.*

3.2. Blockchain Technology and Transparency

BCT is an electronic ledger that authorized individuals can examine but not modify. It can securely record transactions in a decentralized, efficient, and cost-effective manner [74]. BCT can simplify data transfer by removing layers that are frequently in conflict. As a result, information is more dependable, timely, accurate, reliable, visible, and incorruptible. The smart contract [75] is one use of BCT. Self-execution of the smart contract algorithm is dependent on the operations (actions) of the participating entities, which serve as input variables. This eliminates the need for intermediaries to obtain approval, resulting in a reduction in contract processing time.

Blockchain is a technology that links people and corporations who may not always trust one another but have a common goal [76]. Consequently, BCT can enhance HL's long-term profitability by helping to develop confidence among all stakeholders in the financial flow while also minimizing processing wait times. Furthermore, analytics applied to the information stored in the blocks has the potential to improve the understanding of cash flow [73], generate trust and co-ordination, manage resources, demonstrate authenticity and proprietorship, save time, ensure data security, overcome problems that impede information sharing, increase transparency, and ultimately, provide sustainability [19,77]. Several companies, such as Maersk and Walmart, have used BCT in the workplace [78,79]. As a result of BCT, different DRWs participating in DROs can easily acquire and share information on the same system. Accordingly, BCT might be considered a permanent, searchable, and ultimately immutable archive of public records. As a result, we put forward the following hypothesis.

H2: *Transparency and BCT have a positive relationship.*

3.3. Artificial Intelligence and Transparency

AI entails identifying a specific data management problem, formulating a computational formulation for it, and developing an algorithm to solve it [80]. Because AI helps knowledge discovery generate suggestions and deep insights by utilizing intelligent algorithms, it is increasingly used to make data-driven business decisions in diverse corporate and societal contexts. Unlike traditional statistical and operational research approaches, it can learn from current data and adapt to new data streams [24]. Using AI-based solutions will minimize information and cognitive overload caused by massive amounts of data created from numerous streams at any given time, and will reduce aggregated latency [81]. It will shorten the time it takes to perform an analysis, and can assess all data streams in real time to reduce decision latency, which is crucial in a crisis or catastrophe and in safety-critical systems [82]. In HL, AI might be used in a variety of ways. The benefits of this technology enable the creation of decision-support systems for performing supplier

selection, the injection of agility into HL, the mining of patterns from big data for risk identification, and the managing of data from numerous sources, among other things [83]. Furthermore, AI's characteristics make it perfect for combining with other methodologies and technologies to create hybrid decision-support systems [68,83]. In a nutshell, AI is used to determine a specific piece of data, reduce information and cognitive overload, consider newly obtained data, turn data into useable information, and manage data from many sources. Consequently, we propose the following hypothesis.

H3: Transparency is positively linked with IA.

3.4. Transparency and Effective Inventory Management

The effective management of disaster inventory enhances HL sustainability. In HL, warehouses determine the best place for inventory prepositioning. The key deterministic factors, such as cost, response time, security of the localities, etc., are considered important in effective inventory management (EIM) [17]. Furthermore, the main drivers for EIM in DROs are government stability, costs, logistics and places [84], the amount of storage, and local constraints [85]. Among other things, inventory prepositioning and good storage systems are considered for enhancing HL sustainability [84]. Lack of information and poor SC integration are hurdles in the way of EIM. Last mile distribution is the final point in HL, linked through inventory management with the supply of aid from storage to the people devastated by the disaster [59].

Sustainable HL requires a flexible and transparent inventory management system. The recent advancements in technology and the proliferation of information technology may have a stronger impact on the HL process of storing, tracking, distributing, and monitoring resources. The combination of these technologies can enable inventory transparency among the SC's many actors. As a result, incorporating the IoT, BCT, and AI into relief materials will provide the necessary transparency in inventories and logistics, allowing for greater sustainability. As a result, we propose the following.

H4: Transparency mediates the relationship between technology and effective inventory management of DROs.

3.5. Transparency and Robust Information

HL topics can help with proper engagement and correct information exchange in disaster-prone areas, which is crucial to a DRO's long-term viability. Additionally, one of the fundamental characteristics of DROs is uncertainty, which has a direct impact on information sharing. Withholding information in logistics causes an issue known as the bullwhip effect [86], but sharing knowledge can lead to SC sustainability. Furthermore, long-term HL has a significant impact on saving lives, alleviating suffering, and contributing to economic prosperity [87]. In a vein similar to ref. [88], this study suggests that in uncertain circumstances, an organization's ability to share information becomes critically important [89]. Any organization needs both internal and external information in order to run smoothly [90]. Organizations adopt management techniques with the declared purpose of improving their information capabilities to handle challenges produced by an excessively uncertain environment, providing sustainability to the HL process.

Transparency helps with making better HL decisions by removing problems such as lack of information and uncertainty. Bribery can be hidden more easily when there is a lack of transparency. Lack of openness adds to the cost of information [36]. Information management is critical for HL sustainability for the many stakeholders (governments, HOs, foreign governments) and volunteers [24]. In disaster scenarios, there is a dearth of accurate information. Authors have offered formulations to support catastrophe operations in conditions of limited knowledge, bringing transparency through technology that can provide robust information. In this research, the following hypothesis is suggested.

H5: Transparency mediates the relationship between technology and robust information in a DRO.

3.6. Transparency and Effective Donation Management

Donors are the most significant stakeholders in relief operations because they have the most authority. They have their priorities and clear objectives regarding the use of their donations. Therefore, they always expect HOs to use donated funds effectively and efficiently [40]. As a result, they are ready to use their authority to exert pressure on HOs in order to accomplish their goals. Therefore, the main focus of HOs should be to spend donors' resources efficiently to reduce the vulnerability of survivors in a visible way [91]. Proper communication with donors and timely reporting on financial performance [51] are not only important to satisfy donors but are also important for the survival and sustainability of the organization. Overly ambitious strategy creation, aimed at impressing overseas donors and other stakeholders, rather than victims, results in a lack of overall organizational performance [92].

As noted, HOs are usually evaluated by their funders, not their beneficiaries. In addition, the donors' expectations regarding spending vary worldwide [17]. The international community wants to empower victims and help ensure their dignity in all phases of a disaster. Therefore, organizations have been subjected to increased standards of transparency. Diverse donors require detailed data regarding how their donations are spent and on the efficient utilization of resources by the organization. More specifically, they want to record what assistance has been given, to whom, the strategic approach, operational records, the cost structure, and the effect on victims [93]. The key to success in HL is the effective and efficient recording of reliable data, which is critical for donors to formulate policies connected to the release of funding [94]. As a result, the only way to satisfy donors is to guarantee greater transparency in the HL process. Therefore, the following can be argued.

H6: *Transparency mediates the relationship between technology and effective donation management of DROs.*

4. Methods

4.1. Population and Sampling

This study follows the quantitative research design because it statistically examines the mediating role of transparency between emerging technologies and HL sustainability. The quantitative research design helps quantify opinions, statistically justifying the influence of one variable over another. The primary data were collected through an online questionnaire created in Google Drive to test the reliability, validity, model fit, and psychometric accuracy of the study framework. The population of this study included employees working in HOs in Pakistan. Due to the absence of a sampling frame, where the exact total population is not known, a nonprobability technique (snowball sampling) was employed. First, we approached contacts and asked them to fill out the survey and to either provide details on other potential respondents or forward the link to their acquaintances across the country. The sample size was determined following previously crafted guidelines that recommend a 10:1 respondent-to-item ratio for multivariate analysis [95]. This study contains seven latent variables and 36 items/indicators, as shown in Figure 2. Thus, the minimum sample size for this study should be $10 \times 36 = 360$.

4.2. Questionnaire Development and Data Collection

This study followed other previously used guidelines on questionnaire development and instrument validity and reliability [96]. To operationalize the study constructs, measurement instruments (scales) were adapted from the relevant literature. The measurement scale for technology was adopted from [23], while transparency was adapted from [17] and the scale for HL sustainability was extracted from [17,40]. Respondents assessed 36 items on a five-point Likert scale (1 indicates "never; strongly disagree; not probable; extremely untrue of what I believe"; 5 indicates "always; strongly agree; highly probable; very true of what I believe"). The indicators were put together as a whole based on current measurements and research in the English language. Small modifications were made as needed for the circumstances. After the questionnaire was written, it was examined by specialists on

the subject (professors and managers). The questionnaire was revised in response to their feedback to accurately reflect the context of IT in HL. Small changes were made after a pilot test to get the questionnaire ready for data collecting.

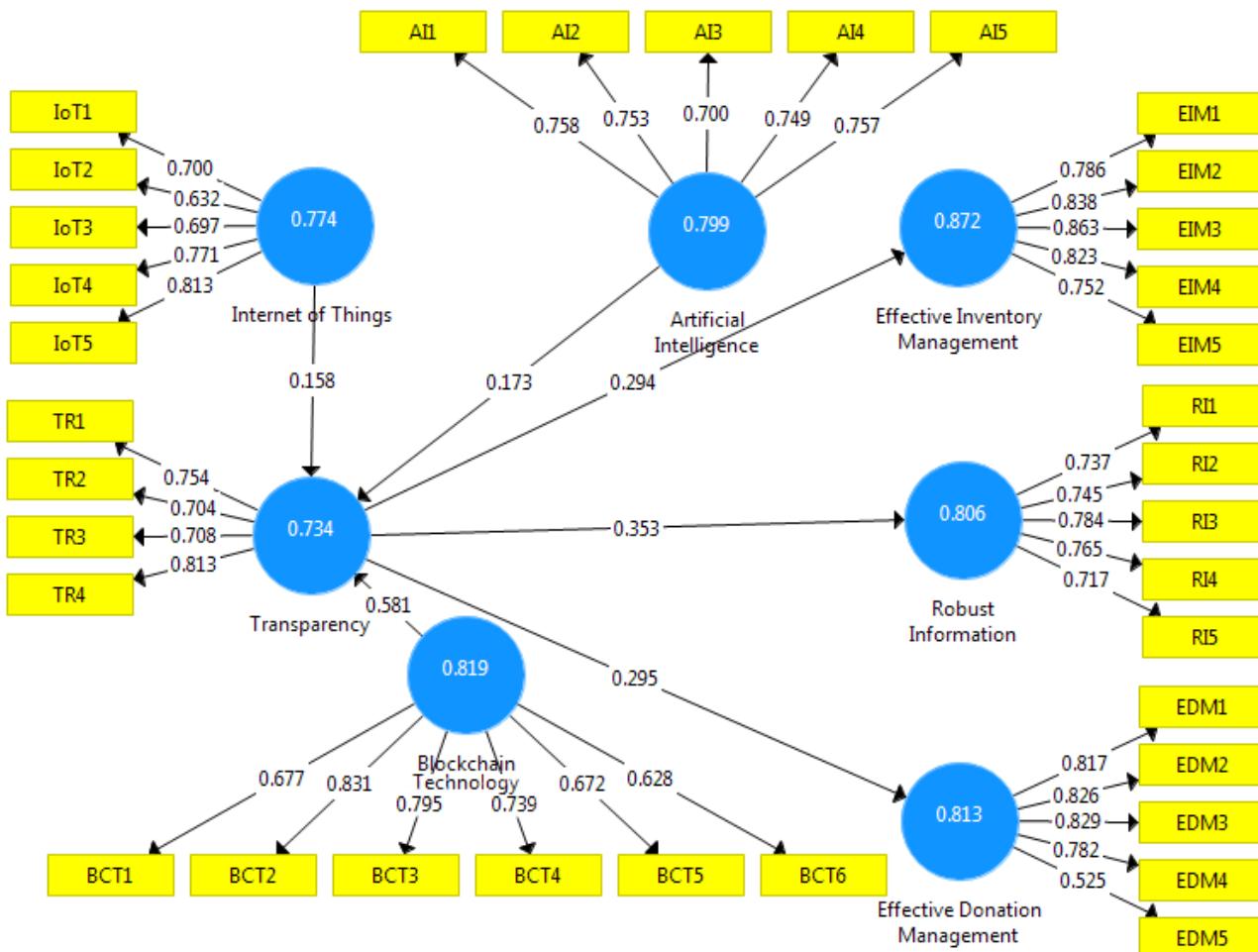


Figure 2. Cronbach's alpha values and reliability.

Based on feedback from the experts and from pretest results, the questionnaire was finalized (see the Appendix A). To protect respondents' privacy, the questionnaire did not ask for any personal information, and participation was entirely voluntary. The information was gathered between September and December 2020. Respondents were contacted through email, Facebook, WhatsApp, and LinkedIn, with a cover letter describing the objective of the survey and assuring each respondent that their information would be kept anonymous and confidential. Following three email reminders, 434 usable responses were obtained.

4.3. Descriptive Statistics

Per the guidelines in ref. [97], biased replies were compared to earlier responses (the first and last 30%), and late respondents were deemed to be nonrespondents. An investigation showed that all measurement items had nonstatistical dis-similarity, $p > 0.25$. As a result, in this study, nonresponse bias was not a concern. Gender, age, qualifications, work experience, company function, and position were all used to regulate the data, which were then analyzed after normality was checked. All questionnaire processes, instructions, orders, and exercises were conducted in Pakistan. As shown in Table 1, 434 HO professionals participated in the study, comprising chief executive officers (21.7%), managers (22.8%), supervisors (30%), logisticians (11.1%), and field officers (14.5%). A total

of 88% of the participants were men, with the majority (43.8%) between the ages of 35 and 44. Most (67.7%) had a master's degree, and 30.0% were supervisors. The mean, standard deviation, variance, skewness, and kurtosis were also calculated.

Table 1. Demographic Information.

Variable	Classification of Variables	Valid	Freq.	%	Mean	Std. Dev.	Var.	Skew.	Kurt.
Gender	Male Female	434	388 52	88 12	1.12	0.325	0.106	2.35	3.537
Age	18 to 24 years 25 to 34 years 35 to 44 years 45 years or older	434	2 189 190 51	0.5 43.5 43.8 11.8	2.66	0.686	0.471	0.478	-0.695
Qualifications	PhD Master's Degree Bachelor's Degree Diploma Secondary school and below	434	28 294 106 4	6.5 67.7 24.4 0.9	2.22	0.603	0.364	1.00	3.379
Experience	Less than 1 year 1–3 years 4–6 years 7–9 years 10–12 years 13 and above	434	110 106 64 76 50 28	25.3 24.4 14.7 17.5 11.5 6.5	2.85	1.568	2.457	0.44	-0.962
Function	Health Logistics Food Security Water, Sanitation, and Hygiene Camp Co-ordination Other	434	76 106 31 14 10 197	17.5 24.4 7.1 3.2 2.3 45.4	3.85	2.109	4.450	-0.112	-1.780
Position	CEO Manager Supervisor Logistician Field Officer	434	94 99 130 48 63	21.7 22.8 30.0 11.1 14.5	2.74	1.312	1.722	0.299	-0.923

5. Analysis and Results

The objective of this study was the prediction and development of theory instead of confirmation, and therefore, a PLS approach is more appropriate in contrast to the covariance-based (CB) approach [98]. In PLS, latent variable values are used if the structural model is complex. This study contains a complex structural model, because it has reflective constructs, observed variables, and latent variables, and all variables possess common themes. Hence, using PLS-SEM, the research model was analyzed in two steps suggested in [98], with SmartPLS 3 applied. In the first phase, the measurement model was analyzed to establish its validity and reliability. The structural/path model was evaluated for hypothesis testing in the second phase. Composite reliability (CR) and Cronbach's alpha were used to assure the measurement model's reliability, while discriminant and

convergent validity tests determined validity. Hypothesis testing for the structural model was undertaken after confirming the measurement model's reliability and validity. SPSS was used to check for normality and multicollinearity before using the SmartPLS3 package. To begin, skewness and kurtosis were used to assess the study's normalcy, as shown in Table 2. The numbers were within the allowed range of ± 2 [99], and the data were normal. Multicollinearity was then checked using a VIF test, where the values must be less than 10 [3,100]. In this study, $VIF < 3$; hence, multicollinearity is not a problem for subsequent considerations.

Table 2. Descriptive and Collinearity (VIF) Statistics.

	IoT	BCT	AI	TR	EIM	RI	EDM
Valid	434	434	434	434	434	434	434
Missing	0	0	0	0	0	0	0
Mean	2.85	2.85	2.98	2.73	3.05	2.89	2.90
Median	2.80	2.80	2.92	2.73	3.06	2.88	2.90
Std. Deviation	0.599	0.599	0.781	0.578	0.676	0.618	0.628
Variance	0.358	0.358	0.610	0.334	0.457	0.382	0.395
Skewness	0.045	0.045	0.059	0.082	0.062	0.066	0.071
Std. Error of Skewness	0.117	0.117	0.117	0.117	0.117	0.117	0.117
Kurtosis	-0.948	-0.948	-1.055	-0.702	-0.722	-0.879	-0.834
Std. Error of Kurtosis	0.234	0.234	0.234	0.234	0.234	0.234	0.234
VIF	1.64	1.79	1.56	1.62	2.19	1.62	1.94

5.1. Assessment of the Measurement Model

Pearson's coefficient, R -squared (R^2), and adjusted R -squared (AR^2) were used to determine the endogenous variables' variance values. R^2 and AR^2 values were very close, as indicated in Table 3. Consequently, the results revealed a big and medium effect size, as well as a well-fit model [17].

Table 3. The Measurement Model's Reliability and Validity.

	R-Squared	Adjusted R-Squared	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Internet of Things			0.774	0.847	0.526
Blockchain Technology			0.819	0.870	0.529
Artificial Intelligence			0.799	0.862	0.553
Transparency	0.571	0.568	0.695	0.805	0.557
Effective Inventory Management	0.152	0.150	0.872	0.907	0.661
Robust Information	0.200	0.198	0.806	0.866	0.562
Effective Donation Management	0.151	0.149	0.813	0.873	0.585

5.1.1. Reliability of the Measurement Model

Cronbach's alpha measures the inner reliability of the variables, whereas CR measures the more lenient reliability of the variables. For exploratory purposes, a reliability of 0.60 or more is acceptable, while in Cronbach's alpha, less than 0.60 suggests the items do not match well. The value of Cronbach's alpha was higher than the suggested value (see Table 3 and Figure 2). Accordingly, the model is well-suited to this study [17].

Likewise, CR values greater than the 0.70 threshold indicate the model fits well and demonstrates great reliability [17,101,102], as seen in Table 3.

5.1.2. Model Validity

Without validity, a model might not be reliable [103]. As a result, both convergence and discriminant validity (DV) tests were used in the study. After deleting the TR5 indicator variable of transparency, the factor-loading values for all of the indicator variables were higher than the threshold value of 0.70. Likewise, the AVE values for all constructs were more than 0.50 [102]. Therefore, the value of factor loadings and the model's AVE demonstrate high levels of convergence among the indicators in assessing their respective constructs, as seen in Table 3 and Figure 3.

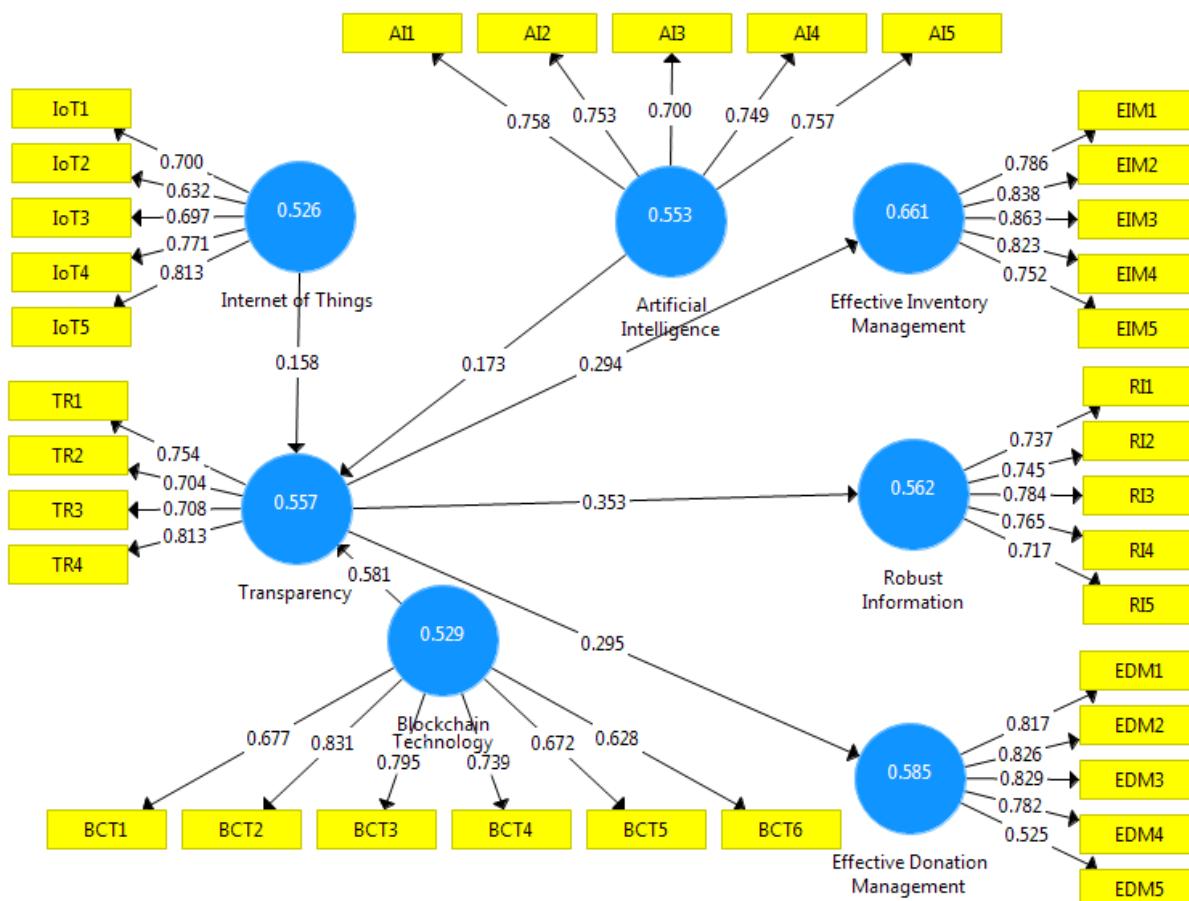


Figure 3. PLS with the AVE values.

There are different methods to estimate discriminant validity. DV was then calculated using the measurement model to see if an item accounted for more variance in its linked manifest construct than it exhibited with other constructs in the associated model [104]. In this research, DV of the constructs was examined via a correlation matrix obtained through SPSS 16, and was compared with the square root (SQRT) of the AVE for each construct. The diagonal elements reflect the SQRT value of the AVE for each construct, and below-diagonal values represent the intercorrelation matrix. The results demonstrate that all values for the SQRT of the AVE were higher than any constructs utilized in this research based on the correlation coefficients of all constructs between the same and all other constructs in the same row or column. As a whole, all measurement items and constructs in this research are appropriate for the estimation of the propositions and for the structural model. As a result, the findings show that all of the study's constructs meet all DV requirements, and no DV issues were found using the Fornell–Larcker criterion [98], as shown in Table 4. However, HTMT is the best approach for the DV in PSL [105].

Table 4. Correlation and the Fornell–Larcker Criterion.

	1	2	3	4	5	6	7
1. Internet of Things	1						
2. Blockchain Technology	1.000 **	1					
3. Artificial Intelligence	0.920 **	0.920 **	1				
4. Transparency	0.817 **	0.817 **	0.891 **	1			
5. Effective Inventory Management	0.829 **	0.829 **	0.896 **	0.995 **	1		
6. Robust Information	0.954 **	0.954 **	0.972 **	0.946 **	0.952 **	1	
7. Effective Donation Management	0.935 **	0.935 **	0.971 **	0.961 **	0.966 **	0.998 **	1

Note: ** Indicates the correlation is significant at the 0.01 level (2-tailed).

As seen in Table 5, the HTMT values of the model were smaller than the cut-off value of ≤ 0.85 [106], except for EIM with effective donation management (EDM), and RI with AI, EDM, and EIM, whereas RI showed transparency with BCT; the rest of the values indicate no issues with DV, showing a fit model and revealed validity.

Table 5. Determining discriminant validity using the HTMT ratio.

	AI	BCT	EDM	EIM	IoT	RI	TR
Artificial Intelligence (AI)							
Blockchain Technology (BCT)	0.34						
Effective Donation Management (EDM)	0.77	0.30					
Effective Inventory Management (EIM)	0.74	0.29	1.13				
Internet of Things (IoT)	0.27	0.58	0.17	0.15			
Robust Information (RI)	0.90	0.36	0.91	0.91	0.23		
Transparency (TR)	0.47	0.89	0.37	0.35	0.61	0.45	

5.2. Predictive Validity

Cohen [107] reported that the values of predictive validity (Q^2) for the Stone–Geisser indicator (0.02, 0.15, and 0.35) presented small, medium, and high impact sizes, respectively. For the present study, the values are 0.26, 0.10, 0.11, and 0.08 for the endogenous latent variables of EDM, EIM, RI, and transparency as seen in Table 6. Hence, the study's Q^2 results demonstrate that the model has a medium level of predictive accuracy, and the variables are essential for the usual adjustment of the framework.

Table 6. Predictive Validity.

	SSO	SSE	Q^2 (=1 – SSE/SSO)
Internet of Things	2170.000	2170.000	-
Blockchain Technology	2604.000	2604.000	-
Artificial Intelligence	2170.000	2170.000	-
Transparency	2170.000	1614.578	0.26
Effective Inventory Management	2170.000	1962.974	0.10
Robust Information	2170.000	1933.018	0.11
Effective Donation Management	2170.000	1989.696	0.08

5.3. Hypothesis Testing

Once the validity and reliability of the measurement models were established, the structural model was assessed for hypotheses testing. The results of hypothesis testing revealed that the IoT had a substantial positive influence on transparency ($T = 3.895$, $p = 0.00$). Accordingly, H1 was confirmed. BCT had a substantial positive impact on

transparency ($T = 15.292, p = 0.00$), which validated H2. AI had an extremely positive and significant effect on transparency ($T = 5.174, p = 0.00$), which supported H3. Transparency had a significant influence on EIM ($T = 6.099, p = 0.00$), which confirmed H4. Transparency substantially affected RI ($T = 7.014, p = 0.00$), confirming H5, and significantly affected EDM ($T = 6.197, p = 0.00$), which validated H6 (see Figure 4 and Table 7).

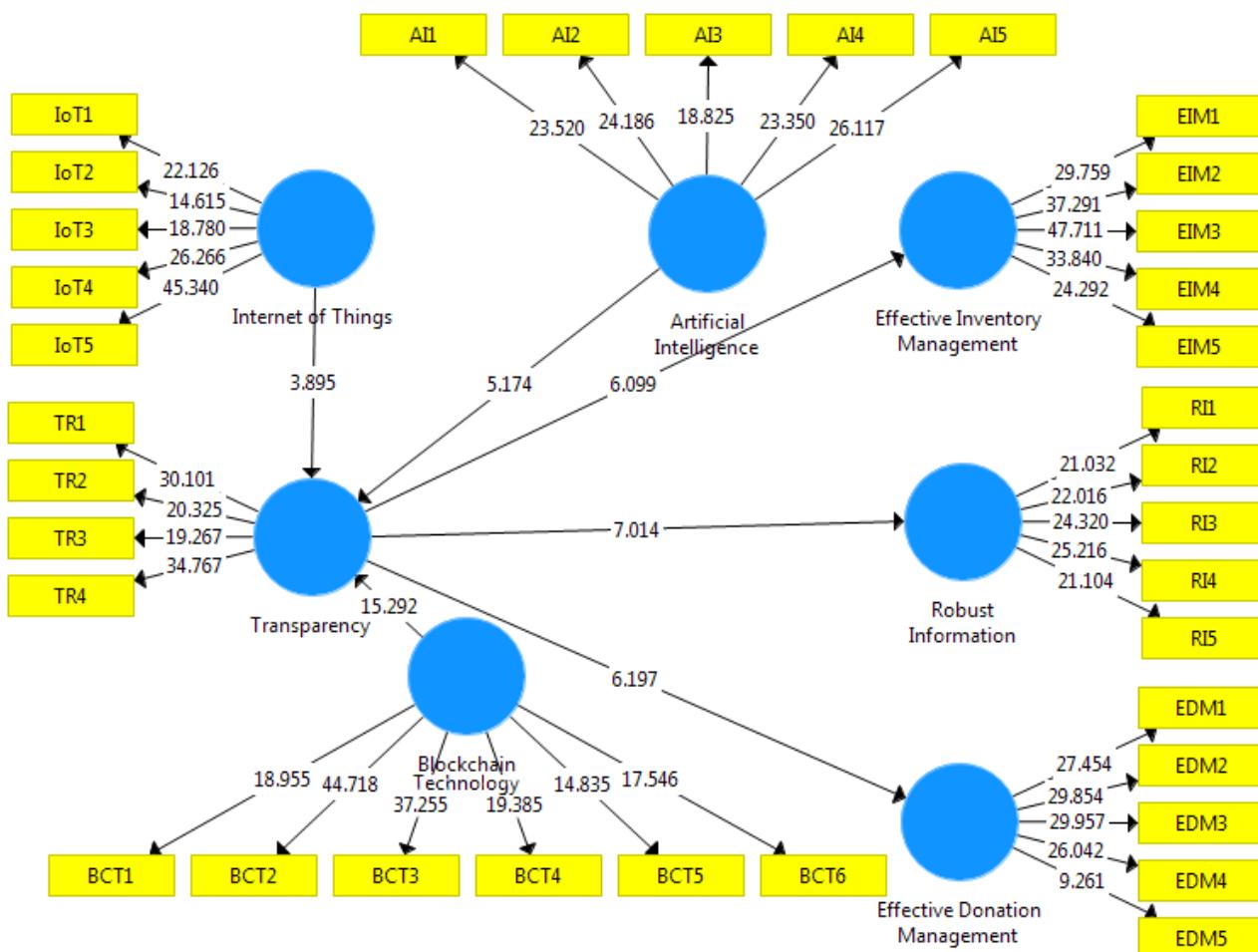


Figure 4. T-statistic value.

Table 7. Path Analysis Using Bootstrapping.

	Path Coefficient	Sample Mean	Std. Deviation	T Statistics	p Values	Supported?
Internet of Things → Transparency (H1)	0.122	0.125	0.038	3.895	0.000	Yes
Blockchain Technology → Transparency (H2)	0.511	0.511	0.038	15.292	0.000	Yes
Artificial Intelligence → Transparency (H3)	0.345	0.346	0.040	5.174	0.000	Yes
Transparency → Effective Inventory Management (H4)	0.390	0.397	0.048	6.099	0.000	Yes
Transparency → Robust Information (H5)	0.447	0.453	0.047	7.014	0.000	Yes
Transparency → Effective Donation Management (H6)	0.389	0.395	0.051	6.197	0.000	Yes

6. Discussion

The objective of this study was to examine the impact on transparency and HL sustainability from integration of the IoT, BCT, and AI. The findings suggest that in Pakistan, where corruption and mismanagement in HL have been the greatest concerns for all stakeholders, emerging technologies in DROs are ways to provide the transparency that can further

enhance information flow and effectiveness in inventory and donation management and, ultimately, sustainability. Overall, the findings of the study are consistent with existing research contending that technology enhances HL sustainability that mainly includes effective inventory and donation management along with robust information. The findings of this study are essential because they validate the technology's multidimensional view in a more thorough manner than earlier research. The hypothesized interrelationship suggested in the structural model between the latent variables was examined through Student T-test interconnection with p values. The result demonstrated that integration of the IoT, BCT, and AI is associated positively with transparency. This confirms hypotheses H1, H2, and H3. Similarly, transparency relates positively to EIM, robust information, and EDM in HOs, supporting hypotheses H4, H5, and H6 (see Figure 4 and Table 7). In addition, the suggested reflecting model has a high predictive significance for the endogenous components of transparency, EIM, robust information, and EDM. Multicollinearity between the variables, which can present difficulty when interpreting the data, was not an issue. Cronbach's alpha, CR, AVE, HTMT, and the Fornell–Larcker criterion revealed relatively strong associations. Similarly, the T-statistic test was also noted to be a substantial or strong descriptive element for all variables.

The importance of the IoT, BCT, and AI in increasing system efficiency and effectiveness is recognized and well researched in numerous other disciplines, as discussed. Additionally, the findings of this research confirm and extend the role of these three technologies as well as the role of transparency as a mediator between technology and the variables of HL sustainability. The findings of the study support earlier research findings: [17,18,23]. The results show that a combination of the IoT, BCT, and AI relates positively to HL sustainability, implying that not using the IoT, BCT, and AI decreases transparency and, ultimately, HL sustainability. On the contrary, the three variables increase HL sustainability and transparency in DROs.

Regulatory authorities and HOs are primarily liable for guaranteeing viable administration and responsiveness to crises. In any case, lack of resources and unreasonable dispensations raised the requirement for truthfulness in the helpful co-ordination of disaster relief. Due to corruption and mismanagement in DROs in Pakistan, relief usually does not reach the victims in time. In such situations, a few financially well-off individuals manage to recover with self-support; however, 31.3% of the population lives in deprived areas, and these areas are profoundly dependent on DROs by the government with the assistance of national and international NGOs. This amplifies the need for transparency in relief operations. Because different natural calamities occur in Pakistan, it is necessary to have a transparent set of policies and strategies for the effective management of disasters. Pakistan, being on the top-10 list of countries most vulnerable to disasters, faces calamities every year. Thus, the existing disaster-relief management system is in dire need of transparent and sustainable HL, which according to the conclusions of this study and earlier research, can be accomplished by integrating the IoT, BCT, and AI into the entire disaster-relief management system.

6.1. Contributions to Theory

Based on these findings, it may be argued that the results provide some key insights into theory. First, the importance of technology and the role of transparency are well acknowledged in the operations and SC literature. Numerous studies have been conducted so far on transparency in HL and on the benefits of technology adoption in the field. However, as discussed in detail in earlier sections, all these studies have been conducted from different perspectives and with different sets of variables. This study, however, examined the three explanatory variables and three response variables mediated by transparency. Second, though research on technology adoption in operations and the SC has a very strong footing, in HL, it has gained momentum in recent years. The existing studies examined specific aspects of technology. This study, however, examined technology from a holistic perspective. In addition, it examined integration of the IoT, BCT, and AI as explanatory

variables in the HL context for the first time and, to the best of our knowledge, no research has empirically examined these associations. As a result, the findings contribute to the body of knowledge by updating and supporting earlier research on HL sustainability. Lastly, this study provides empirical evidence on the role of technology in creating transparency in HL in Pakistan, where the frequency of disasters and mismanagement in DROs are higher. Thus, the present research contributes to the literature from a geographic perspective, i.e., it provides empirical evidence from a developing country where research, in general, is limited when it comes to HL.

6.2. Practical Implications

This study has several practical implications that might be useful to HO management and policymakers. Based on the outcomes, we suggest that the IoT, BCT, and AI should be integrated into disaster management systems. These technologies offer positive changes to the HL sector, such as more easily accessible information, legitimate data, and smart contracts, which will contribute to sustainable HL. The country's image will improve once systems demonstrate transparency in the utilization of financing and dispensing of resources to the impacted individuals at the appropriate time, in the right quantity, and to the right areas. Similarly, through integration of the IoT, BCT, and AI in HL, all HOs may play a critical role in bringing transparency. Though they do not have any direct authority and control over the national disaster relief system, together they can lobby and influence the government to adopt technology for the national system. In addition, they can offer to provide financial and technical support in the process. Nevertheless, the technology of HL in Pakistan initially might not be quite effective due to the low literacy rate and lack of expert DRWs. However, this issue will be transitory and can be overcome by providing relevant training.

6.3. Limitations

There are certain limitations to the study that can be addressed with more research. Nonetheless, this study is the first to empirically examine the incorporation of the IoT, BCT, and AI in HL, and it can be used as a source for further research. Additionally, this study, conducted only in Pakistan, measured only IoT, BCT, and AI integration for HO sustainability; its findings cannot be generalized to other countries. Researchers are urged to conduct studies in other developing and developed countries, as well as to analyze and contrast the effects of the IoT, BCT, and AI on commercial and noncommercial organizations. These findings assessed how the IoT, BCT, and AI may be used to improve HL sustainability, and primary data were acquired from practitioners in various positions within HOs. Other stakeholders such as victims, funders, governments, and the military were not surveyed, and can be considered for future research. Lastly, the study is based on a questionnaire, and these findings can be enriched by using mixed methods in future research.

7. Conclusions

This study examined the integration of the IoT, BCT, and AI to create transparent and sustainable HL. The study results indicate that transparency plays a substantial role as a mediator in the relationship between explanatory variables (the IoT, BCT, and AI) and the response variables (EIM, robust information, and EDM). See Figure 1. The findings are consistent with the existing literature on technology adoption in the SC, which suggests improved sustainability and transparency of systems resulting from technology. In addition to some valuable academic contributions, the findings of this research contribute significantly to HOs, stakeholders as a whole (particularly donors), and governments by providing them with recommendations for understanding the importance of technology and transparency in providing HL sustainability. These parties continuously explore strategies to assist the afflicted, while funders also desire openness and transparency. Mismanagement, corruption, ineffective inventories, and donation management all demand transparency in HL to build the trust of donors and victims. The research contributes to the literature by offering the first

quantitative evidence assessing the key role that the integration of emerging technologies plays in creating transparency in one of the top-10 disaster-prone regions.

Author Contributions: Conceptualization, methodology, writing—review & editing, M.K.; data curation, software, validation, formal analysis, G.S.P.; writing—review & editing, A.A.; writing—review & editing, M.J.; visualization, writing—original draft, writing—review & editing, N.H.; funding acquisition, resources, supervision, J.B. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Construct Operationalization.

S/No	Constructs and Items	References
Internet of Things (IoT)		
1	My organization utilizes the internet of things (IoT) for interorganization information transfer (IoT1).	
2	My organization utilizes the IoT for intraorganization information transfer (IoT2).	
3	My organization utilizes the IoT to create and store information for future use (IoT3).	[23]
4	My organization utilizes the IoT for management of relief materials (IoT4).	
5	I agree with the development of my organization's clarity of information to the stakeholders through the IoT (IoT5).	
Blockchain Technology (BCT)		
1	We use distributed ledger technology to share information during disaster relief operations (BT1).	
2	We use distributed ledger technology because it helps to maintain confidentiality, integrity, and availability of the data (BT2).	
3	We use distributed ledger technology to improve transparency in the disaster relief supply chain (BT3).	
4	We routinely use distributed ledger technology as a data platform that traces the origins, use, and destination of humanitarian supplies (BT4).	[23]
5	We routinely use distributed ledger technology to avoid unreliable information and to avoid confusion among partners engaged in disaster relief operations (BT5).	
6	I feel safe in my information sharing with the organization's blockchain technology (BT6).	

Table A1. *Cont.*

S/No	Constructs and Items	References
Artificial Intelligence (AI)		
1	Artificial intelligence can only be implemented to check human judgment and share information during disaster relief operations (AI1).	
2	Artificial intelligence may prevent errors, and it helps to maintain confidentiality (AI2).	
3	Computers can deal with personal data more carefully than humans to improve transparency in the disaster relief supply chain (AI3).	[108]
4	In my opinion, humans make more errors than computers (AI4).	
5	My organization uses artificial intelligence for disclosure in meeting humanitarian logistics sustainability (AI5).	
Transparency (TR)		
1	We routinely share our operational plans (i.e., distribution and storage plans) (TR1).	
2	Our partners routinely gather strategic information related to disaster-affected areas (TR2).	
3	These emerging technologies can provide me with updated information relevant to the unfortunate industry of disaster (TR4).	[17]
4	The entire process of humanitarian logistics in my organization is accurately and transparently disclosed (TR5).	
Effective Inventory Management (EIM)		
1	Technology and transparency can overcome continuous and sustainable ambiguities in inventory with responsible authority (EIM1).	[40]
2	Through technology and transparency, management can control procurement and effectively plan inventory management (EIM2).	
3	My organization always favors the victims by its conscientiousness in inventory management (EIM3).	
4	My organization performs its role effectively regarding inventory management (EIM4).	[17]
5	Our inventory wastage rates are low (EIM5).	
Robust Information (RI)		
1	My organization facilitates stakeholders in getting the information they need (RI1).	
2	My organization distributes the relief items transparently (RI2).	
3	Our local partners share their strategic information related to local culture, government regulations, and other useful information (RI3).	
4	We routinely share our operational plans (i.e., distribution and storage plans) (RI4).	[17]
5	Our partners routinely gather strategic information related to disaster-affected areas (RI5).	
6	Our organization is open to sharing most information regularly and proactively with the stakeholders (RI6).	

Table A1. Cont.

S/No	Constructs and Items	References
	Effective Donation Management (EDM)	
1	Through technology, management can familiarize itself with the processes involved in the relief of the needy after a disaster (EDM1).	[40]
2	Technology and transparency can help increase the number of donors (EDM2).	
3	The victims can clearly see the progress and situations of the donations of my organization (EDM3).	
4	It is important for us to provide sincere aid to victims in time (EDM4).	[17]
5	We constantly stay in touch with the victims until donations are delivered (EDM5).	

References

- Anjomshoae, A.; Hassan, A.; Wong, K.Y.; Banomyong, R. An integrated multi-stage fuzzy inference performance measurement scheme in humanitarian relief operations. *Int. J. Disaster Risk Reduct.* **2021**, *61*, 102298. [CrossRef]
- Khan, M.; Parvaiz, G.S.; Bashir, N.; Imtiaz, S.; Bae, J. Students' key determinant structure towards educational technology acceptance at universities, during COVID 19 lockdown: Pakistani perspective. *Cogent Educ.* **2022**, *9*, 2039088. [CrossRef]
- Centre for Research on the Epidemiology of Disasters. *CRED Crunch 58—Disaster Year in Review* (2019); CRED: Brussels, Belgium, 2020; Volume 58.
- Haris, M.; Cheema, A.R.; Subasinghe, C. Why lessons learnt are lost. *Disaster Prev. Manag. Int. J.* **2019**, *28*, 677–690. [CrossRef]
- Cheema, A.R.; Mehmood, A.; Imran, M. Learning from the past: Analysis of disaster management structures, policies and institutions in Pakistan. *Disaster Prev. Manage.* **2016**, *25*, 449–463. [CrossRef]
- Debarati, G.-S.; Hoyois, P.; Below, R. *Annual Disaster Statistical Review 2015 The Numbers and Trends*; Universite Catholique de Louvain: Brussels, Belgium, 2016.
- Dube, N.; Van der Vaart, T.; Teunter, R.; Van Wassenhove, L. Host government impact on the logistics performance of international humanitarian organisations. *J. Oper. Manag.* **2016**, *47*, 44–57. [CrossRef]
- Carlson, C.E.; Isihara, P.A.; Sandberg, R.; Boan, D.; Phelps, K.; Lee, K.L.; Diedrichs, D.R.; Cuba, D.; Edman, J.; Gray, M. Introducing PEARL: A Gini-like index and reporting tool for public accountability and equity in disaster response. *J. Humanit. Logist. Supply Chain Manag.* **2016**, *6*, 202–221. [CrossRef]
- Maxwell, D.; Walker, P.; Church, C.; Harvey, P.; Savage, K.; Bailey, S.; Hees, R.; Ahlendorf, M.-L. *Preventing Corruption in Humanitarian Assistance*; Research Report; Transparency International: Berlin, Germany; Feinstein International Center: Boston, MA, USA, 2008.
- Chen, S.; Zhang, Q.; Zhou, Y.P. Impact of supply chain transparency on sustainability under NGO scrutiny. *Prod. Oper. Manag.* **2019**, *28*, 3002–3022. [CrossRef]
- Egels-Zandén, N.; Hulthén, K.; Wulff, G. Trade-offs in supply chain transparency: The case of Nudie Jeans Co. *J. Clean. Prod.* **2015**, *107*, 95–104. [CrossRef]
- Sodhi, M.S.; Tang, C.S. Research opportunities in supply chain transparency. *Prod. Oper. Manag.* **2019**, *28*, 2946–2959. [CrossRef]
- Altay, N.; Pal, R. Information diffusion among agents: Implications for humanitarian operations. *Prod. Oper. Manag.* **2014**, *23*, 1015–1027. [CrossRef]
- Dubey, R.; Gunasekaran, A.; Childe, S.J.; Papadopoulos, T. Skills needed in supply chain-human agency and social capital analysis in third party logistics. *Manag. Decis.* **2018**, *56*, 143–159. [CrossRef]
- Dubey, R.; Gunasekaran, A.; Bryde, D.J.; Dwivedi, Y.K.; Papadopoulos, T. Blockchain technology for enhancing swift-trust, collaboration and resilience within a humanitarian supply chain setting. *Int. J. Prod. Res.* **2020**, *11*, 1–18. [CrossRef]
- Dubey, R.; Bryde, D.J.; Foropon, C.; Tiwari, M.; Dwivedi, Y.; Schiffling, S. An investigation of information alignment and collaboration as complements to supply chain agility in humanitarian supply chain. *Int. J. Prod. Res.* **2021**, *59*, 1586–1605. [CrossRef]
- Khan, M.; Lee, H.Y.; Bae, J.H. The Role of Transparency in Humanitarian Logistics. *Sustainability* **2019**, *11*, 2078. [CrossRef]
- Iqbal, T.; Ahmad, S. Transparency in humanitarian logistics and supply chain: The moderating role of digitalisation. *J. Humanit. Logist. Supply Chain Manag.* **2022**. ahead of print. [CrossRef]
- Aranda, D.A.; Fernández, L.M.M.; Stantchev, V. Integration of Internet of Things (IoT) and Blockchain to increase humanitarian aid supply chains performance. In Proceedings of the 2019 5th International Conference on Transportation Information and Safety (ICTIS), IEEE, Liverpool, UK, 14–17 June 2019; pp. 140–145.
- Min, H. Blockchain technology for enhancing supply chain resilience. *Bus. Horiz.* **2019**, *62*, 35–45. [CrossRef]
- Chen, C. Blockchain for Humanitarian Aid: Problem or Panacea? 2018. Available online: <https://think-asia.org/bitstream/handle/11540/8955/CO18162.pdf?sequence=1> (accessed on 26 March 2022).

22. Ramadurai, K.W.; Bhatia, S.K. Disruptive technologies and innovations in humanitarian aid and disaster relief: An integrative approach. In *Reimagining Innovation in Humanitarian Medicine*; Springer: Berlin/Heidelberg, Germany, 2019; pp. 75–91.
23. Khan, M.; Imtiaz, S.; Parvaiz, G.S.; Hussain, A.; Bae, J. Integration of Internet-of-Things With Blockchain Technology to Enhance Humanitarian Logistics Performance. *IEEE Access* **2021**, *9*, 25422–25436. [[CrossRef](#)]
24. Rodríguez-Espíndola, O.; Chowdhury, S.; Beltagui, A.; Albores, P. The potential of emergent disruptive technologies for humanitarian supply chains: The integration of blockchain, Artificial Intelligence and 3D printing. *Int. J. Prod. Res.* **2020**, *58*, 4610–4630. [[CrossRef](#)]
25. Anjomshoae, A.; Banomyong, R.; Mohammed, F.; Kunz, N. A systematic review of humanitarian supply chains performance measurement literature from 2007 to 2021. *Int. J. Disaster Risk Reduct.* **2022**, *72*, 102852. [[CrossRef](#)]
26. Schnackenberg, A.K.; Tomlinson, E.C. Organizational transparency: A new perspective on managing trust in organization-stakeholder relationships. *J. Manag.* **2016**, *42*, 1784–1810. [[CrossRef](#)]
27. Altay, N.; Labonte, M. Challenges in humanitarian information management and exchange: Evidence from Haiti. *Disasters* **2014**, *38*, S50–S72. [[CrossRef](#)]
28. Haavisto, I.; Kovács, G. Perspectives on sustainability in humanitarian supply chains. *Disaster Prev. Manage.* **2014**, *23*, 610–631. [[CrossRef](#)]
29. Kassinis, G.; Vafeas, N. Stakeholder pressures and environmental performance. *Acad. Manag. J.* **2006**, *49*, 145–159. [[CrossRef](#)]
30. Correia, M.S. Sustainability: An Overview of the Triple Bottom Line and Sustainability Implementation. *Int. J. Strateg. Eng. (IJSE)* **2019**, *2*, 29–38. [[CrossRef](#)]
31. Willard, B. *The New Sustainability Advantage: Seven Business Case Benefits of a Triple Bottom Line*; New Society Publishers: Gabriola Island, BC, Canada, 2012.
32. Kovács, G.; Spens, K.M. Humanitarian logistics in disaster relief operations. *Int. J. Phys. Distrib. Logist. Manag.* **2007**, *37*, 99–114. [[CrossRef](#)]
33. Rabta, B.; Wankmüller, C.; Reiner, G. A drone fleet model for last-mile distribution in disaster relief operations. *Int. J. Disaster Risk Reduct.* **2018**, *28*, 107–112. [[CrossRef](#)]
34. Bealt, J.; Fernández Barrera, J.C.; Mansouri, S.A. Collaborative relationships between logistics service providers and humanitarian organizations during disaster relief operations. *J. Humanit. Logist. Supply Chain Manag.* **2016**, *6*, 118–144. [[CrossRef](#)]
35. Khan, M.; Hussain, A.; Farooq, N.; Sahibzada, S.; Khattak, A.; Malik, S. Applying Interpretive Structural Modeling and MICMAC Analysis to Evaluate Inhibitors to Transparency in Humanitarian Logistics. *Utopía Y Prax. Latinoam.* **2020**, *25*, 325–337.
36. Khan, M.; Yong, L.H.; Han, B.J. Emerging Techniques for Enhancing the Performance of Humanitarian Logistics. *Int. J. Supply Chain Manag.* **2019**, *8*, 450.
37. Khan, M.; Yong, L.H.; Han, B.J. A Systematic Review of Performance Enhancement of Humanitarian Logistics through Transparency: Current Status and Perspectives. *Int. J. Supply Chain Manag.* **2019**, *8*, 549.
38. Nurmala, N.; de Leeuw, S.; Dullaert, W. Humanitarian–business partnerships in managing humanitarian logistics. *Supply Chain Manag. Int. J.* **2017**, *22*, 82–94. [[CrossRef](#)]
39. Van Wassenhove, L.N. Humanitarian aid logistics: Supply chain management in high gear. *J. Oper. Res. Soc.* **2006**, *57*, 475–489. [[CrossRef](#)]
40. Khan, M.; Sarmad, M.; Ullah, S.; Bae, J. Education for sustainable development in humanitarian logistics. *J. Humanit. Logist. Supply Chain Manag.* **2020**, *10*, 573–602. [[CrossRef](#)]
41. Weerawardena, J.; McDonald, R.E.; Mort, G.S. Sustainability of nonprofit organizations: An empirical investigation. *J. World Bus.* **2010**, *45*, 346–356. [[CrossRef](#)]
42. Haavisto, I.; Kovacs, G. Sustainability in humanitarian operations. In *Sustainable Value Chain Management: Analyzing, Designing, Implementing, and Monitoring for Social and Environmental Responsibility*; Gower: Memphis, TN, USA, 2013.
43. ALNAP—Active Learning Network for Accountability and Performance in Humanitarian Action. *An Introduction to Evaluation of Humanitarian Action (EHA): Course Manual*; ALNAP: London, UK, 2007.
44. Delmas, M.; Toffel, M.W. Organisational responses to environmental demands. *Strateg. Manag. J.* **2008**, *29*, 1027–1055. [[CrossRef](#)]
45. Choi, S.; Ng, A. Environmental and economic dimensions of sustainability and price effects on consumer responses. *J. Bus. Ethics* **2011**, *104*, 269–282. [[CrossRef](#)]
46. Cronin, J.J.; Smith, J.S.; Gleim, M.R.; Ramirez, E.; Martinez, J.D. Green marketing strategies: An examination of stakeholders and the opportunities they present. *J. Acad. Mark. Sci.* **2011**, *39*, 158–174. [[CrossRef](#)]
47. Yu, W.; Ramanathan, R.; Nath, P. Environmental pressures and performance: An analysis of the roles of environmental innovation strategy and marketing capability. *Technol. Forecast. Soc. Change* **2017**, *117*, 160–169. [[CrossRef](#)]
48. Larrea, O. Key performance indicators in humanitarian logistics in Colombia. *IFAC Proc. Vol.* **2013**, *46*, 211–216. [[CrossRef](#)]
49. Baraibar-Diez, E.; Odriozola, M.D.; Sánchez, J.L.F. Transparency through European corporate governance codes. *Int. J. Disc. Gov.* **2016**, *13*, 244–261. [[CrossRef](#)]
50. Park, H.; Blenkinsopp, J. The roles of transparency and trust in the relationship between corruption and citizen satisfaction. *Int. Rev. Adm. Sci.* **2011**, *77*, 254–274. [[CrossRef](#)]
51. Anjomshoae, A.; Hassan, A.; Kunz, N.; Wong, K.Y.; de Leeuw, S. Toward a dynamic balanced scorecard model for humanitarian relief organizations' performance management. *J. Humanit. Logist. Supply Chain Manag.* **2017**, *7*, 194–218. [[CrossRef](#)]

52. Burkart, C.; Besiou, M.; Wakolbinger, T. The funding—Humanitarian supply chain interface. *Surv. Oper. Res. Manag. Sci.* **2016**, *21*, 31–45. [[CrossRef](#)]
53. Beamon, B.M.; Balcik, B. Performance measurement in humanitarian relief chains. *Int. J. Public Sect. Manag.* **2008**, *21*, 4–25. [[CrossRef](#)]
54. Lu, Q.; Goh, M.; De Souza, R. A SCOR framework to measure logistics performance of humanitarian organizations. *J. Humanit. Logist. Supply Chain Manag.* **2016**, *6*, 222–239. [[CrossRef](#)]
55. Medina, C.; Rufin, R. Transparency policy and students' satisfaction and trust. *Transform. Gov. People Process Policy* **2015**, *9*, 309–323. [[CrossRef](#)]
56. Najib Razali, M.; Mohd Adnan, Y. Transparency in Malaysian property companies. *Prop. Manag.* **2012**, *30*, 398–415. [[CrossRef](#)]
57. Gershwin, S.B. The future of manufacturing systems engineering. *Int. J. Prod. Res.* **2018**, *56*, 224–237. [[CrossRef](#)]
58. Winkelhaus, S.; Grosse, E.H. Logistics 4.0: A systematic review towards a new logistics system. *Int. J. Prod. Res.* **2020**, *58*, 18–43. [[CrossRef](#)]
59. Roy, P.; Albores, P.; Brewster, C. Logistical framework for last mile relief distribution in humanitarian supply chains: Considerations from the field. In Proceedings of the International Conference on Manufacturing Research, Birmingham, UK, 11–13 September 2012; pp. 11–13.
60. Jung, H.; Chung, K. Ontology-driven slope modeling for disaster management service. *Clust. Comput.* **2015**, *18*, 677–692. [[CrossRef](#)]
61. Sinha, A.; Kumar, P.; Rana, N.P.; Islam, R.; Dwivedi, Y.K. Impact of internet of things (IoT) in disaster management: A task-technology fit perspective. *Ann. Oper. Res.* **2019**, *283*, 759–794. [[CrossRef](#)]
62. Westlund, S. The use of geospatial technology in disaster management. In *Geospatial Technologies and Advancing Geographic Decision Making: Issues and Trends*; IGI Global: Hershey, PA, USA, 2012; pp. 21–34.
63. Khan, M.; Sarmad, M.; Shah, S.F.A.; Han, B.J. Extent of Employee Turnover in Humanitarian Logistics: An Interpretive Structural Modelling Approach. *Int. J. Supply Chain Manag.* **2020**, *9*, 107.
64. Prusty, A.R.; Mohanty, A. Prospect of Low Power Sensor Network Technology in Disaster Management for Sustainable Future. In *Emergency and Disaster Management: Concepts, Methodologies, Tools, and Applications*; IGI Global: Hershey, PA, USA, 2019; pp. 834–856.
65. Wu, Y.C.J.; Lirn, T.C. RFID technology in emergency logistics: An exploratory study. *Int. J. Manag. Enterp. Dev.* **2011**, *11*, 163–181. [[CrossRef](#)]
66. Xu, L.D.; Xu, E.L.; Li, L. Industry 4.0: State of the art and future trends. *Int. J. Prod. Res.* **2018**, *56*, 2941–2962. [[CrossRef](#)]
67. Cichosz, M. Digitalization and competitiveness in the logistics service industry. *e-Mentor* **2018**, *77*, 73–82. [[CrossRef](#)]
68. Dinh, T.N.; Thai, M.T. AI and Blockchain: A Disruptive Integration. *Computer* **2018**, *51*, 48–53. [[CrossRef](#)]
69. Mandolla, C.; Petruzzelli, A.M.; Percoco, G.; Urbinati, A. Building a digital twin for additive manufacturing through the exploitation of blockchain: A case analysis of the aircraft industry. *Comput. Ind.* **2019**, *109*, 134–152. [[CrossRef](#)]
70. Xu, H.; Liu, W.; Wang, C.; Chen, H. Service-oriented management for internet of things. *Int. J. Inf. Netw. Secur.* **2013**, *2*, 54. [[CrossRef](#)]
71. Tzezana, R. High-probability and wild-card scenarios for future crimes and terror attacks using the Internet of Things. *Foresight* **2017**, *19*, 1–14. [[CrossRef](#)]
72. Day, J.M.; Junglas, I.; Silva, L. Information flow impediments in disaster relief supply chains. *J. Assoc. Inf. Syst.* **2009**, *10*, 1. [[CrossRef](#)]
73. Huckle, S.; Bhattacharya, R.; White, M.; Beloff, N. Internet of things, blockchain and shared economy applications. *Procedia Comput. Sci.* **2016**, *98*, 461–466. [[CrossRef](#)]
74. Schatsky, D.; Muraskin, C. Beyond Bitcoin: Blockchain Is Coming to Disrupt Your Industry. Deloitte Insight 2015. Available online: <https://www2.deloitte.com/us/en/insights/focus/signals-for-strategists/trends-blockchain-bitcoin-security-transparency.html> (accessed on 26 March 2022).
75. Saberi, S.; Kouhizadeh, M.; Sarkis, J.; Shen, L. Blockchain technology and its relationships to sustainable supply chain management. *Int. J. Prod. Res.* **2019**, *57*, 2117–2135. [[CrossRef](#)]
76. Cartier, L.E.; Ali, S.H.; Krzemnicki, M.S. Blockchain, Chain of Custody and Trace Elements: An Overview of Tracking and Traceability Opportunities in the Gem Industry. *J. Gemmol.* **2018**, *36*, 212–227. [[CrossRef](#)]
77. Woodside, J.M.; Augustine, F.K., Jr.; Giberson, W. Blockchain technology adoption status and strategies. *J. Int. Technol. Inf. Manag.* **2017**, *26*, 65–93.
78. Lal, R.; Johnson, S. *Maersk: Betting on Blockchain*; Harvard Business School: Boston, MA, USA, 2018.
79. Yadav, S.; Singh, S.P. Blockchain critical success factors for sustainable supply chain. *Resour. Conserv. Recycl.* **2020**, *152*, 104505. [[CrossRef](#)]
80. Marr, D. Artificial intelligence—A personal view. *Artif. Intell.* **1977**, *9*, 37–48. [[CrossRef](#)]
81. Deparday, V.; Gevaert, C.M.; Molinario, G.; Soden, R.; Balog-Way, S. *Machine Learning for Disaster Risk Management*; GFDRR: Washington, DC, USA, 2019.
82. Radianti, J.; Dokas, I.; Boersma, K.; Noori, N.S.; Belbachir, N.; Stieglitz, S. Enhancing Disaster Response for Hazardous Materials Using Emerging Technologies: The Role of AI and a Research Agenda. In *Engineering Applications of Neural Networks*.

- Proceedings of International Conference on Engineering Applications of Neural Networks, Hersonissos, Greece, 24–25 May 2019; Springer: Berlin/Heidelberg, Germany, 2019; pp. 368–376.*
- 83. Baryannis, G.; Validi, S.; Dani, S.; Antoniou, G. Supply chain risk management and artificial intelligence: State of the art and future research directions. *Int. J. Prod. Res.* **2019**, *57*, 2179–2202. [[CrossRef](#)]
 - 84. Roh, S.-Y.; Jang, H.-M.; Han, C.-H. Warehouse location decision factors in humanitarian relief logistics. *Asian J. Shipp. Logist.* **2013**, *29*, 103–120. [[CrossRef](#)]
 - 85. Maharjan, R.; Hanaoka, S. Warehouse location determination for humanitarian relief distribution in Nepal. *Transp. Res. Procedia* **2017**, *25*, 1151–1163. [[CrossRef](#)]
 - 86. Lee, H.L.; Padmanabhan, V.; Whang, S. Information distortion in a supply chain: The bullwhip effect. *Manag. Sci.* **1997**, *43*, 546–558. [[CrossRef](#)]
 - 87. Yigitbasioglu, O.M. Information sharing with key suppliers: A transaction cost theory perspective. *Int. J. Phys. Distrib. Logist. Manag.* **2010**, *40*, 550–578. [[CrossRef](#)]
 - 88. Ataseven, C.; Nair, A.; Ferguson, M. The role of supply chain integration in strengthening the performance of not-for-profit organizations: Evidence from the food banking industry. *J. Humanit. Logist. Supply Chain Manag.* **2020**, *10*, 101–123. [[CrossRef](#)]
 - 89. Galbraith, J.R. *Designing Complex Organizations*; Addison-Wesley Longman Publishing Co., Inc.: Boston, MA, USA, 1973.
 - 90. Thompson, J. *Organizations in Action*; McGraw Hill: New York, NY, USA, 1967.
 - 91. Heaslip, G.; Kovács, G.; Haavisto, I. Cash-based response in relief: The impact for humanitarian logistics. *J. Humanit. Logist. Supply Chain Manag.* **2018**, *8*, 87–106. [[CrossRef](#)]
 - 92. Ahmeda, Z. Disaster risks and disaster management policies and practices in Pakistan: A critical analysis of Disaster Management Act 2010 of Pakistan. *Int. J. Disaster Risk Manag.* **2013**, *4*, 15–20. [[CrossRef](#)]
 - 93. Gavidia, J.V. A model for enterprise resource planning in emergency humanitarian logistics. *J. Humanit. Logist. Supply Chain Manag.* **2017**, *7*, 246–265. [[CrossRef](#)]
 - 94. Abidi, H.; de Leeuw, S.; Klumpp, M. Humanitarian supply chain performance management: A systematic literature review. *Supply Chain Manag. Int. J.* **2014**, *19*, 592–608. [[CrossRef](#)]
 - 95. Hair, J.F., Jr.; Hult, G.T.M.; Ringle, C.M.; Sarstedt, M. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*; Sage Publications: Thousands Oaks, CA, USA, 2021.
 - 96. Saunders, M.; Lewis, P.; Thornhill, A. *Research Methods for Business Students*, 7th ed.; Pearson: London, UK, 2015.
 - 97. Armstrong, J.S.; Overton, T.S. Estimating nonresponse bias in mail surveys. *J. Mark. Res.* **1977**, *14*, 396–402. [[CrossRef](#)]
 - 98. Hair, J.F., Jr.; Matthews, L.M.; Matthews, R.L.; Sarstedt, M. PLS-SEM or CB-SEM: Updated guidelines on which method to use. *Int. J. Multivar. Data Anal.* **2017**, *1*, 107–123. [[CrossRef](#)]
 - 99. George, D. *SPSS for Windows Step by Step: A Simple Study Guide and Reference, 17.0 Update, 10/e*; Pearson Education India: Delhi, India, 2011.
 - 100. Neter, J.; Wasserman, W.; Kutner, M.H. *Applied Regression Models*; Richard D. Irwin Inc.: Homewood, IL, USA, 1983.
 - 101. Ringle, C.M.; Da Silva, D.; Bido, D.d.S. Modelagem de equações estruturais com utilização do SmartPLS. *Rev. Bras. De Mark.* **2014**, *13*, 56–73. [[CrossRef](#)]
 - 102. Chin, W.W. The partial least squares approach to structural equation modeling. *Mod. Methods Bus. Res.* **1998**, *295*, 295–336.
 - 103. Neuman, S.P. Generalized scaling of permeabilities: Validation and effect of support scale. *Geophys. Res. Lett.* **1994**, *21*, 349–352. [[CrossRef](#)]
 - 104. Fornell, C.; Larcker, D.F. Evaluating structural equation models with unobservable variables and measurement error. *J. Mark. Res.* **1981**, *18*, 39–50. [[CrossRef](#)]
 - 105. Voorhees, C.M.; Brady, M.K.; Calantone, R.; Ramirez, E. Discriminant validity testing in marketing: An analysis, causes for concern, and proposed remedies. *J. Acad. Mark. Sci.* **2016**, *44*, 119–134. [[CrossRef](#)]
 - 106. Henseler, J.; Ringle, C.M.; Sarstedt, M. A new criterion for assessing discriminant validity in variance-based structural equation modeling. *J. Acad. Mark. Sci.* **2015**, *43*, 115–135. [[CrossRef](#)]
 - 107. Cohen, J. *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed.; Erlbaum Associates: Hillsdale, NJ, USA, 1988.
 - 108. Ongena, Y.P.; Haan, M.; Yakar, D.; Kwee, T.C. Patients' views on the implementation of artificial intelligence in radiology: Development and validation of a standardized questionnaire. *Eur. Radiol.* **2020**, *30*, 1033–1040. [[CrossRef](#)]