UNDERSTANDING THE INTERSECTION OF VOLUNTEER & TECHNICAL COMMUNITIES (V&TCS) AND TRADITIONAL HUMANITARIAN ORGANIZATIONS

THE ADOPTION AND USE OF V&TCS

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1. Acronyms

AHA Centre	ASEAN Coordinating Centre for Humanitarian Assistance on disaster management
DHN	Digital Humanitarian Network
FAO	Food and Agriculture Organization of the United Nations
HDX	Humanitarian Data Exchange
HHI	Harvard Humanitarian Initiative
HOT	Humanitarian OpenStreetMap
ICT	Information Communication Technology
IFRC	International Federation of Red Cross
IOM	International Organizations for Migration
JOCCIA	Joint Operation Coordination Center for International Assistance
PMI	Indonesian Red Cross
UN	United Nations
UNDAC	United Nations Disaster Assessment and Coordination
UNDP	United Nations Development Program
UNFPA	United Nations Population Fund
UNICEF	United Nations International Children's Emergency Fund
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
UNOG	United Nations Office at Geneva
UTAUT	Unified Theory of Acceptance and Use of Technology
V&TCs	Volunteer and Technical Community
WFP	World Food Program
WHO	World Health Organization
3Ws	Who does What Where

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2. Introduction

On 28 September 2018, earthquakes reaching a 7.7 magnitude struck Central Sulawesi province in Indonesia, and triggered a tsunami with waves of 1.5 meters (IFRC, 2018). Following the earthquakes and tsunami, the horrific conditions led to liquefaction and landslides which further contributed to significant damage and loss of life. Many affected communities were cut-off since communication lines, roads, bridges, and airports were significantly damaged by the disaster (UNOG, 2018). Initial disaster assessments showed there was limited information about the full extent of the disaster, making it a challenge for humanitarian aid to deliver services into affected areas (UNOG, 2018). On October 1, 2018, the Government of Indonesia welcomed offers of international assistance that align with identified humanitarian needs (UNOG, 2018). To support humanitarian information management systems, the Volunteer and Technical Community (V&TCs) provided real-time open-source information from crowdsourced data to augment situational awareness on the needs of the affected areas. The following V&TCs were specifically activated to get a better picture of the unfolding disaster in Indonesia: Standby Task Force (SBTF) (Standby Task Force, 2018), MapAction, and Humanitarian OpenStreetMap (HOT) (World Bank, 2018).

When disasters strike such as Indonesia's earthquakes and tsunami in September 2018, human lives may rely on humanitarian organization's situational awareness for making rapid decisions to deliver aid (Salfinger, Girtelschmid, Proll, Retschitzegger, & Schwinger, 2015). To efficiently understand the crisis situation, humanitarian organizations require timely, relevant, and accurate information to respond to the needs of the affected population (Van de Walle, Van Den Eede, & Muhren, 2009). An effective information system analyzes, disseminates, and provides crucial information for rapid and coherent coordination among humanitarian operations (Currion, de Silva, & Walle, 2007). The earlier humanitarian organizations acquire information to comprehend a disaster's damages, the quicker humanitarian operations can transition into relief activities helping those in need (Currion et al., 2007). However, most humanitarian organizations struggle (eg. in terms of funding, staff capacity, and connectivity) to keep up with new information communication technology (ICT) solutions that can improve information management systems in disaster responses (Currion et al., 2007). With the number of disasters increasing from 50 in 1960

to 350 in 2010 (Bealt, Fernández Barrera, & Mansouri, 2016), further development is needed in humanitarian innovation to provide the best possible help to disaster stricken people.

Despite barriers, traditional disaster responses are changing significantly with the advancement of ICTs and new technical actors (such as V&TCs) extending support to established humanitarian organizations. V&TCs are creating new digital platforms (e.g. crisis-mapping tools) to generate real-time information from crowdsourced data to improve humanitarian organizations' situational awareness and the continuity of disaster response operations. Humanitarian organizations widely recognize the contributions of V&TCs technology, which has led to continuous efforts in bringing V&TCs and humanitarian organizations together in a meaningful way (Sabou & Videlov, 2016). Therefore, interest in the participation and potentialities of V&TCs technology in humanitarian action has grown, but establishing this working collaboration has been complex and difficult (Harvard Humanitarian Initiative, 2011). Academic literature lacks a deeper understanding of how V&TCs are integrated into humanitarian organizations information management systems (Meier, 2015).

To progress the efficiency and effectiveness of humanitarian innovation in disaster responses, further research is needed on how the V&TCs technology is adopted and used to increase humanitarian organizations' internal information management. The adoption of new technology is difficult to predict and to introduce in an active disaster operation, as it may be disruptive and ineffective. Several acceptance theories and adoption models exist and are utilized to study ICTs as well as understand user adoption behavior with technology (Fan, Liu, Zhu, & Pardalos, 2018). It is essential to comprehend the inherent value in the V&TCs technology to leverage the full potential value of V&TCs, while reflecting humanitarian principles. Thus, new research on V&TCs technology adds value to academic literature and generates new knowledge. Furthermore, it informs the humanitarian innovation industry whether to invest funds and time into V&TCs technology as well as staff-training.

This study therefore aims to provide insight and determine how V&TCs improve internal humanitarian information management approaches in the context of disaster responses. The study intends to answer the following research question: *How do humanitarian organizations*

responding to a disaster adopt and use crowdsourced data applications developed by Volunteer and Technical Communities? This research will offer significant knowledge for humanitarian information management on the benefits and challenges of adopting and using V&TCs technology within humanitarian organizations. The perceptions of V&TCs and humanitarian organizations will be explored in the specific case of Indonesia's earthquakes and tsunami in September 2018 to understand the current state of affairs and how to improve the adoption of V&TCs technology.

To address the research question, the explorative study will start with a discussion of the existing literature on crowdsourced data within the humanitarian sector, humanitarian information management systems, background information on V&TCs, current information management practices with V&TCs, and technology adoption and use theories. Second, a description of the methodology will outline the qualitative research design used to answer the research question. Third, the research project's case study of the September 2018 natural disaster in Central Sulawesi, Indonesia will be reviewed to highlight relevant facts and important issues. Fourth, the study's findings will identify and describe key elements on how humanitarian organizations adopt and use V&TCs. Fifth, the analysis will elaborate and explain the meaning of the findings. Lastly, the conclusion will concisely answer the research question, recognize the study's limitations, and make recommendations for future research.

3. Theory

3.1 Valuable Data from Capable Crowds

With information being a keystone in humanitarian disaster responses, there is a growing movement within humanitarian aid to use big crisis data (Meier, 2015). Big crisis data is defined as all datafiable information concerning the disaster which people knowingly and unknowingly share electronically (directly or by means of an intermediary) (Mulder, Ferguson, Groenewegen, Boersma, & Wolbers, 2016). Citizens are no longer passive individuals watching the news or waiting for their rescue, but instead active participants in disaster responses by creating real-time and open data in the forms of posts, texts, tweets, and images (Meier, 2015). Open data refers to information that is freely available and accessible to the public to use as needed (Mulder et al., 2016). Hidden in this enormous amount of gathered real-time data is new valuable information,

but it is too large to turn into actionable information using traditional database technologies (Chen, Mao, & Liu, 2014).

Through crowdsourcing and open-sourced public technology platforms, shared citizen big crisis data is harnessed and filtered into valuable data that could provide humanitarian aid organizations with a new way to maximize effectiveness and reach. Crowdsourcing is termed the method of producing a small and functional dataset from user generated big crisis data, by cleaning and processing existing verbalized or written shared information (Mulder et al., 2016). Crowdsourced data can help humanitarian organizations assess the damage and plan a response, since real-time information can assist in making more informed decisions based on the changing crisis environment. By improving the circulation of information from the communities in need to the humanitarian organizations trying to help through crowdsourced data, humanitarian organizations can form optimal strategic plans to achieve core humanitarian principles: preventing and alleviating human suffering while ensuring respect for all human beings (Hilhorst & Schmiemann, 2002).

Crowdsourced data has arguably changed the humanitarian field indefinitely. To attend to the challenges of creating accurate, quick, and valuable information from big crisis data, a global network of digital volunteers has formed. This "network of loosely affiliated people bound by a humanitarian calling and access to the Internet and Twitter" are known as digital humanitarians (Meier, 2015, p xii). These individuals are at the ready to come together and develop new technology to interpret large quantities of digital data as well as provide insight on disaster affected areas within hours- not days or weeks (Meier, 2015). The digital tools built and staffed by digital humanitarians assist in providing quicker and comprehensive information, which can better align crisis responders' efforts with real-time situations (Meier, 2015). Thus, crowdsourced technological tools are impacting information management systems within humanitarian organizations and changing the way humanitarian organizations deliver aid.

For example, volunteer-driven open source platforms have specifically recognized information management challenges in the initial phase of a crisis, which led to the creation of crowdsourced maps with geospatial data that is freely accessible (Mulder et al., 2016). It is challenging for

humanitarian responders to receive satisfactory information about the disaster at the beginning of a crisis, as there is limited access on up-to-date layouts of affected areas, and locations of critical infrastructures and services (Mulder et al., 2016). The lack of information on the 3Ws (who is doing what, where) hinders humanitarian responses, and signifies the importance of up-to-date maps. As a result, V&TCs have been used multiple times (e.g. 2010 Haiti earthquake, 2013 Philippine typhoon, 2015 Nepal earthquake, and 2017 United States hurricane Harvey) to monitor and filter new critical information in disasters to produce crowdsourced crisis maps for humanitarian organization's information management.

3.2 Information Management

A central role in humanitarian information management is avoiding gaps and duplication in humanitarian relief actions (Van de Walle et al., 2009). These humanitarian information systems consist of "information technology (hardware, software, networks) obviously, but also include infrastructure (technical infrastructure such as telecom or even electricity, as well as human infrastructure or people capable of working with the system), participants (those who operate or contribute to the system), processes, and ultimately customers or end-users" (Van de Walle et al., 2009, p. 13). Within these dynamic systems, information management involves "various stages of information processing from production to storage and retrieval to dissemination towards the better working of an organization; information can be from internal and external sources and in any format" (Van de Walle, et al., 2009, p. 12; as cited in AIM, 2005). Through these humanitarian information management work processes, the aim is to successfully provide reliable and useful information which is exchanged between all the parties in the humanitarian aid network.

A discussion on the multiple humanitarian information management systems in disaster responses goes beyond the scope of this research study; however, an explanation on the information management flow of crisis crowdsourced data is provided to comprehend how V&TCs can relay actionable information to traditional humanitarian organizations. Data is created from people's local knowledge on a specific crisis. As this knowledge is processed and transferred to create valuable insights from crowdsourced data, it is mutated several times. First, the datafication of individuals shared explicit and tactic information is transformed into written or spoken words for crowdsourcing platforms (Mulder et al., 2016). Second, the supplied information is translated into

English from the local language for data processors and analysts to access the data. In relation to this, Mulder et al. (2016) notes, that a two-way translation should be conducted to ensure the affected population without English language skills are included. Next, technical volunteers take the translated information and make judgements about categorizing, labelling, and filing the data into pre-existing data structures (Mulder et al., 2016). Lastly, analysts at responding organizations must interpret the data, and integrate it with other types of collected data to provide leaders with valuable insights to assist with decision-making. The creation of crowdsourced data involves many choices, as data migrates from the data originator to data processors, and then to the data users (Mulder et al., 2016). Thus, the information collected, processed, and analyzed can augment disaster responses, but it can also endanger people affected by the crisis in question, if the data is misrepresentative or inaccurate (Van de Walle et al., 2009).

Despite the aforementioned potential risks, investment in disaster information processing tools with a view to mitigating risks remains low, along with Information Technology staffing in humanitarian organizations (Van Gorp, 2014). As such, inadequate information processes pose a major problem for humanitarian workers during disaster responses. According to Bharosa, Janssen, Tan (2011), crisis response actors can experience the following difficulties in the flow of information: data availability (especially in the first hours of a disaster), data consistency and correctness, data reliability, adequate streams of information, and timely information. This has led NGOs and international organizations to increasingly request support from V&TCs (Van Gorp, 2014). Hence, there is a growing acceptance of V&TCs assisting in humanitarian operations that deal with human suffering produced by natural disasters and situations of armed conflict. To that end, V&TCs crowdsourced data application efforts are tackling a difficult problem, and the ways in which it supports humanitarian action is changing information workflows.

The humanitarian initiative of crowdsourced platforms developed by the goodwill of V&TCs not only assist humanitarian workers and the public during disasters, but also correspond with humanitarian principles to some degree (Soden, Budhathoki, & Palen, 2014). These entirely volunteer-driven networks comprise of transparent and grassroot movements; low setup and maintenance costs; and adaptableness for specific circumstances (Van de Walle et al., 2009). Yet, a more critical enquiry in academic literature is needed on how innovative technology is being

launched in the humanitarian sector relating to core humanitarian principles, and its effects in achieving humanitarian principles (Sandvik, Gabrielsen Jumbert, Karlsrud, & Kaufmann, 2014). Humanitarian operations abide by a set of established principles (humanity, neutrality, impartiality, and independence) based on international humanitarian law to guide assistance efforts (Hilhorst & Schmiemann, 2002). These principles ensure that actors delivering aid to those suffering do not have adverse effects, or create new insecurities for the individuals (Sandvik, Jacobsen, & McDonald, 2017). This "do no harm" principle emphasizes that humanitarian actions must take necessary steps "to avoid exposing people to further harm as a result of your actions" (Sandvik et al., 2017, p. 5). Thus, the implementation of innovative technology in the humanitarian field needs to provide solutions to better support humanitarian action, as well as uphold traditional humanitarian principles (Sandvik et al., 2014).

For that reason, to successfully integrate new information initiatives into humanitarian organizations, both of the information management and technology components need to incorporate humanitarian principles and best practices. As information is vital for humanitarian action, strengthening humanitarian information management systems should be a priority. To enhance humanitarian information management gathering, the Geneva 2008 Symposium+5 established the following guiding principles: (1) accessibility- access for everyone by providing languages, easy platform, and online and offline channels; (2) inclusiveness- involvement of multiple stakeholders at the national and local government, and affected community level; (3) inter-operability- all sharable data is formatted to retrieve and use the information easily by humanitarian organizations; (4) accountability- information provider is responsible for published and disseminated content; (5) verifiability- information is correct, consistent, and validated by an external source; (6) relevance- data is practical and focused on operational needs to support decision-making; (7) impartiality- variety sources used; (8) humanity- data respects dignity of victims and not used misleadingly; (9) timeliness- information is up-to-date; (10) sustainability- data is preserved and archived; (11) reliability- user is reliable and credible for data delivered, as the source is known; (12) reciprocity- two-way information exchange with the affected community and humanitarian community and (13) confidentiality- all personal data requires informed consent, and safeguarded to protect the data (UNOG, 2008).

To better reflect the delivery of information management for humanitarian action in today's unique setting, the Global Symposium +5 revised the 2002 Symposium principles by adding reliability, reciprocity, and confidentiality (UNOG, 2008). First, reliability is essential to guarantee the validity and verifiability of information. Users must know the source of information and method of data collection to assess the credibility of the data, and ensure global standards are being followed (UNOG, 2008). Next, reciprocity information processes between the affected communities and humanitarians needs to be a constructive two-way exchange (UNOG, 2008). Third, confidentiality entails processing personal data according to its described purpose for which the individual provided informed consent. The security and integrity of the data as well as its sources is also maintained, as necessary safeguards are implemented to protect against the loss, misuse, and unauthorized processing of data (UNOG, 2008). With further development in innovative information tools, the latest standards are crucial to ensure wide usage and well-maintained data (UNOG, 2008). Thus, innovative information management technology should be founded on these principles to prevent information-sharing challenges across collaborative networks such as V&TCs and humanitarian organizations.

3.3 Volunteer and Technical Communities

To begin with, the 2010 Haiti earthquake is known for being a game changer in humanitarian technology (Sandvik et al., 2014). It was the first major disaster in which V&TCs played a vital role in providing information management assistance. The disaster catalyzed the emergence of social media and mobile technology to voice pleas for help by members from the affected community of the disaster (Harvard Humanitarian Initiative, 2011). Meanwhile, traditional humanitarian organizations were too fragmented, poorly equipped and trained, and unprepared to handle the rapid rate and large number of information sources as well as volumes of data (Harvard Humanitarian Initiative, 2011). This pushed humanitarian responders towards V&TCs crowdsourced technology to gain better situational awareness. Over a three-week period, thousands of volunteers around the globe collected, filtered, aggregated, translated, verified, analyzed, and plotted the requested data on maps. The remote volunteer technical mappers created from scratch a base layer map to support the disaster response (Soden & Palen, 2014). The volunteer-driven project called HOT was used to make geospatial data free and openly available for disaster response (Harvard Humanitarian Initiative, 2011). This project was believed to have

provided richer information for humanitarian organizations, long-term sustainability strategy for HOT in Haiti, and gave rise to digital volunteerism of crisis mapping from crowdsourced data (Soden & Palen, 2014). Through HOT efforts in Haiti, other V&TCs could observe how to assist humanitarian efforts beyond Haiti (Soden & Palen, 2014).

Since the Haiti disaster, thousands of citizens from around the world have teamed up and formed V&TCs to fill the technology competency gap and help make sense of information during disaster responses (Harvard Humanitarian Initiative, 2011). V&TCs differ from traditional humanitarian organizations as the community is based on open data, open-source technologies, and non-hierarchical structures (Capelo, Chang, & Verity, 2012). V&TCs have expertise in multiple areas such as geographic information systems, database management, social media, and online campaigns (Van Gorp, 2014). In a traditional sense of delivering food and healthcare, V&TCs do not specialize in humanitarian assistance but instead offer information services and technology to support humanitarian responses. As there is no universally accepted definition for V&TCs, it is largely understood as a volunteer-based community that uses and contributes technical abilities as well as specialized services to support humanitarian responses (Capelo et al., 2012). These virtual volunteers can work with established humanitarian organizations from anywhere in the world to support and augment traditional humanitarian systems (Sabou & Videlov, 2016). Therefore, V&TCs have enabled unprecedented ways to collect and share information in disaster responses.

At this point in time, V&TCs are not part of an established humanitarian sector but their network has performed key tasks in coordinating information during disasters (UN, 2016). There is building evidence to substantiate the impact of V&TCs in humanitarian disaster responses, as they collaborate more and more with formal humanitarian organizations as well as NGOs (Capelo et al., 2012). V&TCs are evolving into a more formal organization with procedures and standards (UN, 2016). A consortium of V&TCs, known as the Digital Humanitarian Network (DHN), has been established to liaise faster with the numerous V&TCs teams (Digital Humanitarian Network, n.d.). The DHN also acts as an interface between V&TCs and professional NGOs, as it accepts activation requests and aims to respond to each request within 24hours (Digital Humanitarian Network, n.d.). In addition, the DHN verifies and enhances V&TCs work (Capelo et al., 2012). To further the formalization of V&TCs services to aid traditional humanitarian organization, both

entities need to familiarize themselves with each other and be willing to learn as well as act together. In the course of working together, new opportunities and challenges will likely materialize to better understand and establish a clear workflow in the future (Capelo et al., 2012).

Despite limited information on the relations between V&TCs and humanitarian organization, the integration process of V&TCs applications into humanitarian organizational practices and routines during a disaster appears to be complex. According to Van Gorp (2014), there are six main barriers to collaboration with humanitarian organization and V&TCS. First, V&TCs limited availability of staffing could affect humanitarian organizations willingness to collaborate. Second, both for the V&TCs internally and between the V&TCs and humanitarian organizations, the management of volunteers is challenging due to the high workload and low staffing ratio (Van Gorp, 2014). Third, V&TCs volunteers have different levels of expertise, and more individuals need to understand the humanitarian principles for efforts to abide by them. Fourth, a good level of V&TCs commitment is required to uphold standards of information security, as the internal processes of volunteers have not always produced such results (Van Gorp, 2014). Fifth, V&TCs and humanitarian organizations have different work structures which could make collaboration difficult. Lastly, humanitarian organizations have limited knowledge about V&TCs expertise and well-established networks do not exist, causing information flow between the two communities to be limited. Therefore, several typical interorganizational collaboration barriers such as trust, commitment, structural constraints, and early technology adoption are present, but humanitarian organizations (e.g. UNOCHA, Red Cross, and World Bank) agree on the promise of new V&TCs technology (Van Gorp, 2014). Humanitarian organizations and V&TCs need to better understand each other to maximize the benefits of such a collaboration.

3.4 Current Information Management Practices: V&TCs Technology

Over the last few years, V&TCs have assisted traditional humanitarian organizations multiple times. Currently, V&TCs are providing digital support to humanitarian organizations by offering services in mapping, media tracking and monitoring, data cleaning, coding and hacking, visualizations and analytics, emergency telecommunications, and social support (Digital Humanitarian Network, 2015). The size of a V&TCs organization ranges from large to small and medium. To date, many V&TCs organizations that have joined the DHN which include: United

Nations Volunteers Online, CartONG, Sahana Software Foundation, Statistics Without Borders, gnucoop, Help Earth Foundation, Connected Development, HOT, Disaster Tech Labs, SBTF, CrisisCommons, DataKind, Humanity Road, Translators without Borders, URISA's GISCorps, PeaceGeeks, Info4disasters, and Geeks Without Bounds (Digital Humanitarian Network, 2015). Thus, many V&TCs are motivated and prepared to deliver assistance to humanitarian organizations based on their technical abilities.

Even though V&TCs crowdsourced data technology for disaster response is still in its infancy stage, humanitarian organizations have recognized and are actively using the significant potential V&TCs hold to enhance humanitarian information management. Successful collaborations between V&TCs and formal humanitarian organizations have involved: CartOng in Haiti, Geeks Without Bounds in Hurricane Sandy, GISCorps in Mozambique, HOT in Haiti, Humanity Road in Philippines, iMMAP in Pakistan, MapAction in Central African Republic, and Standby Task Force in Philippines (Waldman, Verity, & Roberts, 2013). One of the key areas of requests for V&TCs activations appears to be mapping by humanitarian organizations such as UNICEF, UNOCHA, and World Bank (Van Gorp, 2014). According to Van Gorp (2014), the V&TCs supporting this request for humanitarian organizations consist of MapAction, HOT, CrisisMappers, SBTF, GEO-CAN, and GISCorps. Crisis-maps produced by V&TCs reflect the current physical environment of the location comprising of interactive mapping with information collection (who is doing what, and where), and visualization (pictures from satellite imagery or affected citizens) (Dugdale, Van de Walle, & Koeppinghoff, 2012). As such, V&TCs mapping services vary depending on how the humanitarian organizations need to use the information.

For example, a recent and well-documented case illustrating how humanitarian organizations adopt the latest V&TCs mapping technology services is the 2015 Nepal earthquake. In the aftermath of the 2015 Nepal earthquake, thousands of volunteers were activated from the HOT to produce maps with satellite imagery (Mulder et al., 2016). The local nonprofit organization called Kathmandu Living Labs (KLL) worked together with HOT to coordinate mapping activities (Poiani, Rocha, Degrossi, & Albuquerque, 2016). Detailed maps were created by mapping buildings, streets, other physical features, and relief-oriented duties such as helipad locations and Internal Displaced People camps (Anhorn, de Albuquerque, & Herfort, 2016). After constructing

valuable data into mapped features, humanitarian organizations could benefit from the information generated by gaining situational awareness on the disaster. As a result, relief efforts could better locate people in need, and provide goods as well as services to the affected areas (Poiani et al., 2016). Thus, the potential of V&TCs crowdsourced data applications being an advantageous technological innovation for humanitarian information management has been identified in literature. However, there is limited knowledge on whether humanitarian organizations will trust and accept these tools with the intention to adopt it for improving information management.

3.5 Acceptance and Use of Technology

To ensure humanitarian organizations successfully adopt V&TCs crowdsourced data applications for augmenting information management, it is necessary to examine the use of the technology in practice. The alignment of people, processes, and technology drives improvement in software development productivity (Hassan, Hayiyusuh, & Nouri, 2011). New crowdsourced data applications hold great promise, but the application is only as good as the people utilizing it and the procedures established for V&TCs and humanitarian organizations to effectively work together. People must be willing to collaborate, and share information and resources to facilitate the success of a new application (Hassan et al., 2011). A number of studies have discussed the different use cases of V&TCs crowdsourced data applications; however, there is limited knowledge on whether the humanitarian community has enough knowledge, trust, and acceptance of the technology to intentionally adopt it. To not waste time and innovation funds, it is important to know whether humanitarian professionals support the use of V&TCs technology.

For this reason, a better understanding of user adoption behavior with V&TCs technology is needed to optimize the impact of people, processes, and technologies. According to Fan, Liu, Zhu, & Pardalos, 2018, there are a number of acceptance theories and adoption models utilized to study information communication technology. The most commonly and successfully used theories for analyzing technology acceptance includes the following theories: theory of reasoned action, technology acceptance model, motivational model, theory of planned behavior, combined technology acceptance model and theory of planned behavior, model of PC utilization, innovation diffusion theory, and social cognitive theory (Alharbi, 2014). After reviewing these models, Venkatesh, Morris, Davis, & Davis (2003) integrated elements of the listed theories to formulate

the unified theory of acceptance and use of technology (UTAUT). The original eight theories contributing to the UTAUT model explained 17 to 53 percent of the variance in user intentions to utilize technology; meanwhile, the UTAUT model explained 69 percent (Williams, Rana, & Dwivedi, 2015). The latter will be discussed in more detail below.

The UTAUT theory uses four constructs to determine user's acceptance and usage behavior (performance expectancy, effort expectancy, social influence, and facilitating conditions), and four control variables (gender, age, experience, and voluntariness of use) (Venkatesh, et al., 2003). First, performance expectancy refers to the extent a person believes the technology will assist them in increasing their job performance (Venkatesh, et al., 2003). This construct pertains to the technologies perceived usefulness, advantages, and results expectancy. Second, effort expectancy signifies the ease of use with the technology (Venkatesh, et al., 2003). This relates to the technologies perceived ease of use, complexity, and similarity to other technology settings. Third, social influence is defined as the perceived importance of others for an individual to use the technology (Venkatesh, et al., 2003). This construct involves the perceived subjective norms, appearances to other, and social factors. Fourth, facilitating conditions implies the extent of support from an organization to use the technology (Venkatesh, et al., 2003). This signifies the perceived existence of technical methods of support, compatibility, and organizational assistance to use the technology. The model suggests to explore each of the four constructs in a real-world setting to evaluate an individual's intention to use the technology system (Williams et al., 2015). As a result, the essential factors influencing the acceptance of the technology system will be identified in the researched context.

The UTAUT is a validated and well-established model used to predict and describe individual behavior associated to the adoption of technology (Fan, et al., 2018). In 2015, it was measured that the original article by Venkatesh et al. (2003) was cited just under 5,000 times in discussions pertaining to a large span of technologies (Williams et al., 2015). Through these other studies, research has also indicated that trust in technology leads to trust-related behaviors such as intent to adopt a technology (Fan et al., 2018). This construct of trust refers to an individual's confidence in the technological capabilities, and that it will perform as intended (Fan et al., 2018). Therefore,

previous studies have incorporated trust as a main construct to the UTAUT model (figure. 1) to better explain the acceptance of a technology (Alharbi, 2014).

For the purpose of the current study, the revised UTAUT model will be used as a baseline to investigate the adoption and use of V&TCs technology in humanitarian organizations. As the revised model of UTAUT is intended to assess individual user's acceptance of a technology opposed to complex organizational technology adoption, only certain aspects of the revised UTAUT model will be used to understand decision processes in adopting and using V&TCs technology in humanitarian organizations. The model's constructs of performance expectancy, effort expectancy, social influence, facilitating conditions, and trust will be used to develop a rich foundation for the study's open-ended questions about the intent and how humanitarian organizations adopt and use V&TCs technology. More clarification on the preferences and uncertainties of V&TCs technology will reveal small significances, which will be built upon to provide deeper understanding in the process of humanitarian organizations adopting and using V&TCs technology. Given the uncertain and often insecure context of a disaster, humanitarian organizations are also adopting and using V&TCs technology in an unstable environment compared to typical organizations. Therefore, the time restraints in humanitarian fieldwork do not allow humanitarian organizations to learn and check all the elements in the revised UTAUT model. Nevertheless, features of the revised model of the UTAUT can strengthen the understanding of adopting and using V&TCs technology in the dynamic and challenging sector of humanitarian aid.

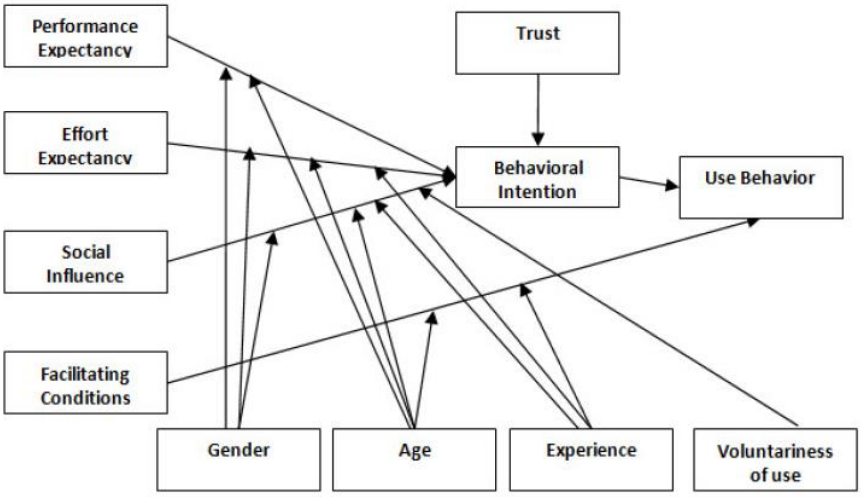

Figure 1: Revised UTAUT model (Alharbi, 2014).

4. Methodology

To provide an answer to the main research question, this section of the report presents and justifies the study's research design: type of research design, case selection, methods of data collection, measurement of key variables, methods of data analysis, and potential validity issues. First, the research was designed as an inductive and exploratory study that aimed to provide more insight into the process of V&TCs technology adoption and use by humanitarian organizations in unpredictable disaster response conditions. The empirical research question's goal concentrated on explaining the process of V&TCs technology adoption and how humanitarian organizations use the information in their internal information management.

An interpretive research approach was used to foster understanding on the process of V&TCs technology adoption and use. Grounded theory methods were used to gain a broader understanding on the actors and V&TCs technology, by gathering and analyzing data from different websites such as Humanitarian Response, ReliefWeb, KoBoToolbox, and Displacement Tracking Matrix. The study's qualitative research also generated and explained concepts through various actors' understanding of their own contexts within disaster response on V&TCs technology adoption and use. This provided a more open and flexible research design to reformulate prior knowledge during the research process. Data collection and data analysis was intertwined to determine as well as explain important concepts on V&TCs technology adoption and use within disaster response. In

addition, the research used sensitizing concepts derived from the revised UTAUT model to provide possible lines of inquiry for the research question. The revised UTAUT model is a validated academic model that clarifies technological challenges of trust and acceptance with individual users. The model only served as a guide in the research study to assist in determining humanitarian organizations' adoption methods and usage behavior of the V&TCs technology. The UTAUT theory was designed for individuals and not complex organizations in insecure disaster settings, making the four control variables irrelevant and thus not necessary to analyze for this research study. In addition, humanitarian action is an immediate response, making the mechanisms different from an ordinary business organization due to how they function in this context.

Given the humanitarian sector's large and dynamic landscape in crisis management, this research project used a case study. To understand V&TCs crowdsourced data applications being used to augment humanitarian information management, it was best to conduct an in-depth investigation on many features within one case. The case study needed to be a recent natural disaster, where V&TCs crowdsourced data applications were used to provide disaster responses. It was logical to use a recent case, as humanitarian organizations and V&TCs would be able to accurately reflect on how V&TCs crowdsourced data applications were currently being utilized and adopted by humanitarian organizations in the field to date. The selected case also needed to be a natural disaster because V&TCs crowdsourced data applications more commonly support humanitarian organizations in natural disaster response efforts. A case concentrating on disaster response was preferred, since it generated crowdsourced data for humanitarian organization's information management teams to use effectively and efficiently.

Bearing these key features in mind, ReliefWeb's leading humanitarian information source of reliable data was consulted to help narrow down the exact case study for the research project (ReliefWeb, 2018). When searching in ReliefWeb's disasters section, Indonesia was listed as one of the most affected countries. This is due to the fact that Indonesia is located on the Pacific Ring of Fire, making it an exceptionally disaster-prone nation (Ellis-Petersen & Lamb, 2018). Based on this information, it was discovered that one of the most recent and serious natural disasters occurred in Indonesia. On September 28, 2018 in Central Sulawesi, Indonesia, an initial 7.5 magnitude earthquake occurred, and was followed by over 150 additional aftershocks causing a

tsunami with waves that reached six meters high (Ellis-Petersen & Lamb, 2018). Additionally, this led to liquefaction and landslides in the affected area (UNICEF, 2018). In Central Sulawesi, the city of Palu was home to approximately 300,000 people, and it was struck the hardest by the disaster (Ellis-Petersen & Lamb, 2018). At that point, there were more than 2,000 deaths, 11,000 severely injured, 83,000 displaced people, and 671 missing people (UNICEF, 2018). More than 67,000 houses were also damaged and many of the regions 2,700 schools could be destroyed as well (UNICEF, 2018). According to the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA), the number of casualties will likely increase as areas become more accessible for the Government in Indonesia to conduct assessments (UNOG, 2018). Furthermore, the Indonesian Government actively requested specific support from the international humanitarian community (UNOCHA, n.d.). With these applicable occurrences corresponding to the study's outlined case study criteria, the disaster of earthquakes and a tsunami in Central Sulawesi, Indonesia on September 28, 2018 was selected as an appropriate case study for the research project.

Next, the study used cross-sectional research to gather the data all at once. This provided a clear picture of the concepts being examined within the short thesis timeframe. The targeted sample was identified through the humanitarian response websites operations contact list displayed on the country tab of Indonesia. The selected humanitarian organization interviewees were restricted to the cluster of logistics, as the data collected and used in this cluster was less invasive and harmful. The V&TCs eligible to be part of the target population were only the ones activated during the earthquakes and a tsunami in Central Sulawesi, Indonesia on September 28, 2018. As the contact lists primarily provided details on organization's email addresses, the selected humanitarian organizations were approached and contacted by email with an invitation to participate in the study. The email notified the humanitarian organization of their opportunity to participate in a voluntary study; the topic and purpose of the study; the reason why the participant was invited; that an interview took between 20 to 30 minutes of their time; and to ask any questions or concerns in relations to the study. Additionally, it requested any contact information, or individuals willing to briefly discuss their disaster responses involving V&TCs technology. This led to the use of a snowball sampling method, as interviewees provided access to difficult to reach organizations through their recommendations of further potential interview participants within the identified

targeted sample population. The key interviewees used their personal social network to identify organizations with suitable features and referred them as a desirable source associated to the research project. After the initial contact with the participants, communication was mainly conducted through email and occasionally WhatsApp. The data collection component of the research project was performed between November 19, 2018 and December 10, 2018, and a complete dataset was attained.

Following the overall aims of the study, the method of data collection involved a semi-structured interview with open-ended questions. Instead of using closed-ended questions answered with a limited set of possible answers, open-ended questions were used to discover new elements by accessing the respondent's true feelings. This allowed participants to deliver authentic responses in their own voice with the ability to elaborate on ideas entirely free of restraint. The semi-structured interview strategy prepared the interviewer with starting questions and follow-up questions to stimulate the interviewee for sufficient information on the research topic being discussed. Based on the semi-structured interview format, the interviewee was also able to provide greater and deeper insights that a prior survey design may not have taken into consideration. As such, in-depth interviews were conducted to discern and make sense of others' interpretations of V&TCs technology adoption and utilization by humanitarian organizations within the specific environment of disaster response. After the interviews were conducted, a substantial amount of time was dedicated to transcribing the interviews from verbal conversations to written words. Indexical transcripts were created from what was said during the interview, organized by the differentiation of the speakers, and proofread for accuracy several times. The transcriptions for the interviews were made to simplify the overall process of reading, analyzing, and interpreting the collected data for the researcher. The collected dataset in a written layout was more concise and easier to review. In addition, at the request of some of the participants, transcriptions were shared with the interviewees which further validated the data. Therefore, through a comprehensive analysis of interpreting and examining the transcripts of interview conversations, more high value explanations on V&TCs crowdsourced technology adoption and use by humanitarian organizations was presented than previously available.

Given the importance of ethics in conducting research, ethical considerations were acknowledged, promoted, and adhered throughout the research project. A number of research ethics were taken into account in the study's qualitative research design to ensure that it was conducted in the right manner. These ethical concerns comprised of the following: informed consent, confidentiality, the protection of personal privacy, how much stress the research study imposes, and true knowledge that avoids errors. First, the interviewees informed consent was addressed by the participants being informed about the study, and voluntarily providing permission to be interviewed for the research project. To better foster a relationship with the participants, verbal consent from the interviewees was accepted instead of a highly formalized approach through written consent. Second, the data was collected and held confidentially as the interviewee's name was not recorded in the study. The collected data was affiliated to the position and organization of the participants, rendering the researcher the only one possible to identify the interviewees. The researcher emphasized the confidentiality of the information being collected to establish a safe environment for the participants to speak freely and share their knowledge. Third, the dataset was kept in a secure location to protect the personal privacy of all the contributed information disclosed safe. Fourth, the research design considered how much stress the research imposed on the participants and assured that no sensitive issues were raised to protect the interviewees. The participants were asked if they had any additional comments or concerns at the end of the interview as well. Lastly, the researcher ensured that true knowledge was used in the study by avoiding errors, preventing the misrepresentation of data, and excluding misinformed results. The quality and integrity of the data for research in the humanitarian sector and technology was abided and upheld.

The study had a sample size of 10 participants. The qualitative research attainted saturation point during the data collection process of the interviews, since no new concepts and information were being presented. The interviewees consisted of humanitarian organizations (UNFPA, UNOCHA, UNICEF, and HDX), V&TCs (HOT, and SBTF), an NGO (CARE International), an initiative (REACH), and experts (humanitarian worker, and information management consultant) in the humanitarian field. The location the researcher conducted the interviews was standardized, as well as the internet-based methods of communication used through Skype to conduct qualitative interviews for the research study. The method of using Skype was selected to reach interviewees around the world (Indonesia, Columbia, USA, and several central European time zone countries)

in a time efficient and monetarily affordable manner. This was the best possible nonrandom convenience sample drawn from the population conveniently available to participate in the study to examine the intricate perspectives of multiple V&TCs, and humanitarian organizations adopting and using V&TCs technology.

In accordance with the study's exploratory and qualitative nature, methods of contextualization were conducted as reviewing literature helped refine what information was relevant to the research question. The main constructs outlined in the revised UTAUT model's framework were bench mark attributes providing a general sense of reference and guidance. The constructs were operationalized by sensitizing the concepts to shape the study. For this reason, the revised UTAUT model's performance expectancy, effort expectancy, social influence, facilitating conditions indicators, and trust merely suggested directions along which to build further analysis to examine behavioral intentions and use of V&TCs technology. Sensitizing concepts acted as interpretive devices and shed light on important features within the complex research context. With the research being driven by data, the collected data primarily from open-ended interview questions generated more insight on humanitarian organizations' behavior intentions to adopt and use of V&TCs technology. While remaining open to all possibilities, this process involved looking for relationships within the dataset. Thus, the adoption and use of V&TCs technology by humanitarian organizations was better understood through interpreting the qualitative answers.

To comprehend the usability and relevance of the information collected in the interviews, the study used inductive data analysis processes to obtain qualitative findings. The data analysis approach involved coding schemes and processing interview data to understand the collected dataset. Initially, prior theories such as the revised UTAUT model were used as a starting point to come up with interview questions and organize the coding schemes of the interview data. The method of coding consisted of structuring the study's data, by compiling the information into summarized groups and assigning them with appropriate coding categories. Using the interview transcriptions, the researcher uncovered the codes through reading, interpreting, analyzing, and connecting concepts repeatedly presented in the interviews. This constituted an important part in the data analysis, as codes and code categories were built on information being synthesized and interpreted in the collected dataset. Based on this approach, the researcher tapped into the

concepts as well as subsequent dimensions within the research's specific case study setting. As a result, a coding system for analyzing the information in the interview transcripts was developed from evaluating the commonalities and differences in the dataset, plus understanding the research's complex context better. The developed codes comprised of super-ordinate codes that emerged from the research question and theories, and emergent codes formed while reading the collected data. Through further interpretations of the interview transcriptions, some of the code categories were reexamined and refined to correspond better with the information in the dataset. The coding categories' characteristics were not specified, as they were more abstract to include a range of all the applicable responses. A codebook was created to document the codes, and the consistent procedures used for interpreting and applying the codes. Thus, the data analysis process identified and classified relevant information, and highlighted important findings.

Recognizing that every research project has limitations, this research study has potential validity and reliability issues. First, the external validity of the results was low because of the small sample size of ten participants, and specific criteria that was used to select the V&TCs and humanitarian organizations being interviewed. There was also limited validity within the data resulting from the snowball sampling selection bias, since it was difficult to generalize to the targeted sample population. Second, the limitations regarding the internal validity involved the lack of representation of humanitarian organizations that were not connected to the social network from which the interviewees were selected; therefore, they might have been underrepresented in the research projects sample. Lastly, the interviews were semi-structured, decreasing the study's reliability as its flexible interviewing technique is inherently difficult to replicate.

However, these limitations were critically examined and reasoned. The objective of the study was not to generalize the results to the larger population of humanitarian information management disaster responses, apart from the theoretical generalization. The study was also limited to a small sample, because of time and budget limitations. This presented opportunities for future research to conduct a study with a larger sample size to generalize the results. The internal validity of the study was increased, by using different organizations (humanitarian organizations, and V&TCs organizations) and various internet resources (HDX, Humanitarainresponse.info, ReliefWeb,

Humanitarian Response, and Displacement Tracking Matrix) to collect data. Additionally, the internal validity of the final research design depended on the quality of the open-ended interviews, and the selection of trustworthy participants. Therefore, it was vital to construct valuable interviews, and use reputable participants. Furthermore, it was beneficial to use semi-structured as it provided deeper responses.

5. The Central Sulawesi, Indonesia Case

The deadliest earthquake to hit in 2018, and within Indonesia since the 2006 Yogyakarta earthquake, occurred on 28 September 2018 (Displacement Tracking Matrix, 2018). In Indonesia, the province of Central Sulawesi was struck with powerful earthquakes that triggered a tsunami on the coast of the province's capital Palu (UNOCHA, 2018b). The location of the tremor was 77km away from the city of Palu and its strongest earthquake was at a depth of 10km (Displacement Tracking Matrix, 2018). Due to the physical geography of Palu, it was more vulnerable to a hazardous tsunami as waves were funneled through the bay with no means to escape except overflowing inland (Displacement Tracking Matrix, 2018). Once the main tremor struck, the nearby Makassar Strait broadcasted a tsunami alarm that was turned off after 30 minutes (Displacement Tracking Matrix, 2018). However, in other areas the anchored tsunami buoy device used to detect sudden changes in undersea water pressure did not work; hence no tsunami alarm system was set-off, and the residents in the affected area were not warned about the tsunami (Displacement Tracking Matrix, 2018). Adding to the destruction, the combined earthquakes and tsunami led to landslides and ground liquefaction in the area, causing entire villages to be overcome by mud on the land they were built (UNOCHA, 2018b).

Reports showed extensive devastation in the affected areas of the region. The building structures 400 meters from the coastline along Talise beach were left crumbling and collapsing, as well as destroyed (UNOCHA, 2018a). At this stage, there were approximately 1,000 people missing, more than 2,000 people dead (UNOCHA, 2018b), at least 65,733 houses destroyed (Displacement Tracking Matrix, 2018), and 2,700 schools, 20 health facilities, and 99 religious buildings damaged (Humanitarian Country Team in Indonesia, 2018). This also left around 330,000 people without adequate shelter, and 71,000 of the displaced people from the disaster to stay in displacement sites with limited access to life-saving services (UNOCHA, 2018a). Due to the earthquake and tsunami,

mobility and transport logistics infrastructures were also severely ruined. The electricity and telecommunication were cut off in most of Palu and Donggala, which restricted their connection to outside help for many days (UNOCHA, 2018a). The control tower was destroyed and 20% of the airport's runway in Palu was wiped out, resulting in all commercial flights to be cancelled and 2,000 meters of the undamaged runway to be used by the military and government agencies for humanitarian activities (Displacement Tracking Matrix, 2018). The cranes that the region depended on for fuel supplies in the seaport to deliver and unpack cargo were wrecked as well (UNOCHA, 2018a). In addition, the main roads for transportation stretching north from Makassar, east from Poso, and south from Garontalo, were impassable with the damage and debris obstructing passage (UNOCHA, 2018a). Furthermore, this most recent disaster only took place a few months after Lombuk, Indonesia was hit by a number of earthquakes (Displacement Tracking Matrix, 2018).

In view of the fact that Indonesia is a disaster-prone location *per se*, the Government of Indonesia has had considerable experience and competence to cope with the havoc caused by natural disasters. After the sudden and rapid destruction as well as loss of life from the earthquakes and tsunami in the September 2018 case examined in this study, emergency responders were mobilized to provide assistance. Straightaway, local disaster responses started rescue attempts to help individuals trapped and suffering in fallen buildings (Humanitarian Country Team in Indonesia, 2018). These immediate actions of search, rescue, and save were performed by the following: residents (hundreds of people), Indonesian Red Cross (PMI), the National Search and Rescue Agency, Indonesian National Armed Forces, and local government agencies (Humanitarian Country Team in Indonesia, 2018). On 4 October 2018, certain areas of Palu had their power restored but other parts were still without electricity (UNOCHA, 2018a). Due to the limited availability of fuel, regular equipment and services were not working such as water pumps, generators, and vehicles (UNOCHA, 2018a). This resulted in residents of Palu waiting in lines for as long as two hours to receive access to clean drinking water. Others also stated that shops and grocery stores were closed for the most part, and health services were running low on basic medical equipment and materials (UNOCHA, 2018a). Since the size of the disaster was substantial, complex emergency responses were needed to help those affected.

On 1 October 2018, international assistance aligning with already established humanitarian needs from on the ground assessments were welcomed and accepted, by the Government of Indonesia's National Disaster Management Agency and Ministry of Foreign Affairs (UNOCHA, 2018a). Along with the announcement from the Government of Indonesia's National Disaster Management Agency, regulations were outlined for international NGOs providing assistance in the Central Sulawesi disaster. The rules specified by the National Disaster Management Agency were the following:

> "(1) foreign NGOs are not allowed to go directly to the field. All activities must be conducted in partnership with local partners; (2) foreign citizens who are working with foreign NGOs are not allowed to conduct any activity on the sites affected by disasters; (3) foreign NGOs who are already procured/ prepared relief items in Indonesia need to register their assistance with the relevant ministries/ agencies & mandated to work with local partners in distributing the aid; (4) if the respective NGOs have not registered their assistance with the relevant ministries/ agencies, they are asked to register with BNPB for the distribution to the affected population on the field; (5) foreign NGOs wishing to provide aid can do so through the Indonesian Red Cross (PM) or PMI's- with the guidance of the related ministries/ agencies or local partners; (6) foreign NGOs who have deployed its foreign personnel are advised to retrieve their personnel immediately; (7) a monitoring of foreign volunteers is required; (8) the delivery of relief items are being coordinated temporary by BNPB through Makassar & Balikpapan." (BNBP, 2018, p. 1)

The preference for local NGOs to participate in humanitarian responses over foreign aid is a normal premise within humanitarian action (Lyons, 2018), as it builds up their local capacity to respond to future disasters. Despite these restrictions from the National Disaster Management Agency of Indonesia, a number of international humanitarian organizations provided support to assist in immediate disaster relief operations to alleviate the suffering of those affected by the disaster in Central Sulawesi. For example, this included international humanitarian organization such as IOM, IFRC, UNICEF, FAO, WFP, UNFPA, UNOCHA, UNDP, Save the Children, World Vision, REACH, UNDAC Mercy Corps, MapAction, and Care International (JOCCIA, 2018). Disaster responses by humanitarian partners and others also included Humanitarian Data Exchange and OSM (AHA Centre, 2018). As a result, the Government of Indonesia's ministries worked

closely with UN agencies, and NGOs to provide the necessary technical support in assisting those affected by the disaster (UNOCHA, 2018a).

On 5 October 2018, the Humanitarian Country Team in Indonesia discussed with the government and formulated a Central Sulawesi Earthquake Response Plan of $50.5 million US for immediate relief operations, and support from the international humanitarian community for three months to assist the affected people (UNOCHA, n.d.). In support of the government-led response, the plan highlights how the humanitarian community can provide technical assistance and relief items (Humanitarian Country Team in Indonesia, 2018). The main sectors of humanitarian action that required the most funding were the cluster groups of shelter ($15.6M); health ($7M); logistics ($6.5M); Camp Coordination and Camp Management ($6M); and Water, Sanitation and Hygiene ($5M) (Humanitarian Country Team in Indonesia, 2018). Partners in the logistic cluster response assisted BNPB and AHA Centre to support operational decision making, and the accuracy, timeliness, and effectiveness of humanitarian disaster response (Humanitarian Country Team in Indonesia, 2018). This involved activities such as arranging trucks and aircrafts to transport international relief items; deploying staff for ground handling at airports; logistic capacity assessments in Palu and other affected areas; arranging the removal of debris; and making storage available (Humanitarian Country Team in Indonesia, 2018).

Furthermore, while performing the Central Sulawesi Earthquake Response Plan, V&TCs technology was used. The main V&TCs identified, referenced, and used to provide assistance for humanitarian actions were the SBTF (Standby Task Force, 2018) and HOT (World Bank, 2018). The SBTF is a network of hundreds of digital humanitarians with specialized skills in building crisis-maps, collating information, delivering reports on the 3Ws, and producing remote assessments of damage (SBTF, n.d.). In this specific disaster, the SBTF supported the association of Indonesian journalists in understanding the social media communications landscape in order for the association to be more effective in delivering accurate and correct information for those requiring it (SBTF, personal communication, November 21, 2018). Meanwhile, HOT is an opensource tool used around the globe for collaborative mapping and geospatial data, which is based on OSM (a community driven open and edible map of the world) (HOT, n.d.). HOT's crisis mapping tool provided accessible and daily updated datasets at 23:00 hours UTC+7 on the city of

Palu and Donggala Regency (roads, infrastructure, points of interest, and waterways) (AHA Centre, 2018). This conveyed helpful knowledge for the Government of Indonesia, NGOs, humanitarian organizations, and those affected by the disaster. Throughout the Central Sulawesi disaster response, the use of HOT appeared to be far greater compared to SBTF. Therefore, more information was available on humanitarian organization's adoption and use of HOT, than SBTF.

6. Findings

This study uses both inductive and deductive coding while performing the data analysis. To begin with, the information presented in the collected data from the interviews is reviewed, but also what is missing from the dataset. The dataset is analyzed with codes that developed from the theoretical framework, such as the revised UTAUT models' constructs: performance expectancy, effort expectancy, social expectancy, facilitating conditions, and trust. Afterwards, the dataset is further examined for repeating patterns associated to the research question on how humanitarian organizations responding to a disaster adopt and use crowdsourced data applications developed by V&TCs emerged. These additional themes were given a code that describes them, since the data provides details and important insights into the research question. Through this coding process, five predetermined themes and two emerging themes were coded. As a result, a total of seven themes were identified and analyzed to the point that no further insights could be gained by additional data analyses. These themes extract relevant data from the dataset to support the research question.

6.1 Perceptions of V&TCs Technology

The extent to which a person believes that a certain technology will assist them in increasing their job performance is discussed as an important element for the adoption and use of technology in the UTAUT revised model's construct of performance expectancy. This theme is characterized in the data, but to better capture the data answering the research question, it is here refined to humanitarian organization's perceptions of V&TCs technology. This theme identifies whether humanitarian organizations' *perceptions of V&TCs technology* is positive or negative. Humanitarian organizations seem to be more likely to adopt and use V&TCs technology if it is perceived positively, instead of negatively. To discover additional information on humanitarian organizations' perceptions of the V&TCs technology, two subthemes are identified: prior

experiences, and relevance for organization tasks. *Prior experience* takes into account the benefits and challenges that a humanitarian organization has experienced in earlier encounters with V&TCs technology. The *relevance for organizational tasks* considers the humanitarian organizations' perceptions of the V&TCs technology's usefulness as a tool to assist the organization in completing its disaster response role. The higher the benefits a humanitarian organization encounters in prior experiences with V&TCs technology, and finds it relevant as well as useful for performing its tasks, a humanitarian organization will likely perceive V&TCs technology positively and consequently be more likely to adopt and use V&TCs technology. Followingly, when humanitarian organizations have challenging prior experiences with V&TCs technology and little relevance for it to perform their tasks, they will probably perceive it negatively and refrain from adopting and using V&TCs technology.

In this study, the dataset presented that humanitarian organizations had both positive and negative perceptions of V&TCs technology. UNOCHA (personal communication, December 10, 2018) explained, that in the Haiti earthquake the "World Health Organization (WHO) was having tremendous difficulty trying to geocode where health facilities had been prior to the Haiti earthquake" and asked for help to locate all the pre-earthquake clinics, health centers, and hospital sites. Instead of receiving the information a week later, as anticipated, the information was delivered the following morning. "That was when I think we first got the inkling that there is this whole big volunteer community out there that were keen and willing to do something and actually can be tremendously helpful and supportive"; since a group of university students on the east coast of the United States completed the work for WHO overnight (UNOCHA, personal communication, December 10, 2018). According to UNOCHA (personal communication, December 10, 2018), after the Haiti earthquake, there were several more events that made them start to consider V&TCs to be interesting for their work, which eventually made working with V&TCs common sense. For example, in January 2010, digital volunteers added value to the humanitarian response in the Chile earthquake; and further provided very important support for humanitarians creating the Libya crisis online map reports for the security council meeting on the capacity of collecting information (Humanitarian worker, personal communication, November 29, 2018). In addition, in the aftermath of the November 2015 Haiyan typhoon in the Philippines, V&TCs made it possible to

create a damage assessment in less than 6 hours (Humanitarian worker, personal communication, November 29, 2018).

On the other hand, humanitarian organizations have encountered negative experiences with V&TCs technology as well. In Bangladesh, in September 2017, there were issues with the map's completeness, and footpaths were incorrectly digitalized as roads on OSM (REACH, personal communication, December 10, 2018). When REACH was deployed to Cox's Bazar, Bangladesh, it was a challenge for them to productively engage with HOT early on (personal communication, December 10, 2018). As REACH realized it was going to take a long time to connect with HOT, they "just made the decision to do it ourselves. With one and later two analysts, they finished digitizing [building footprints] in three days" (personal communication, December 10, 2018).

Despite some humanitarian organizations' prior experiences with V&TCs technology not always being positive, it is mostly perceived that V&TCs technology is useful and brings added value. For example, in the case of Indonesia, OSM is much more detailed than Google Maps (Information Management Consultant, personal communication, December 3, 2018). The OSM maps provided information on all the buildings, individual building footprints, and road maps (HOT, personal communication, November 29, 2018). When OSM's data is updated during the pre-disaster period, it is a "very good proxy for total building count for administrative area, and then you can assign a population value based on that" (REACH, personal communication, December 10, 2018). The roads are also helpful for logistical planning and understanding of the routes (HOT, personal communication, November 29, 2018). In addition, OSM offers a common frame of reference, which is considered useful for humanitarian organizations conducting more deep and detailed assessments (Information Management Consultant, personal communication, December 3, 2018). In addition, some humanitarian organizations believe that V&TCs technology possesses potential, but they are critical of the usefulness of information displayed in crowdsourced crisis maps, for instance in OSM. V&TCs design and display a visually appealing crisis map of where an intervention is being provided; however, some organizations argue that not enough contextual information is provided, such as whether the intervention is enough for the whole population (UNICEF, personal communication, November 29, 2018). The capacity to understand what is actually happening from the maps is a challenge. Thus, humanitarian organizations' perceptions

of V&TCs technology are mixed, as prior experiences vary from country to country and the technology's usefulness for a task depends on the specific job being carried out.

6.2 Characteristics of V&TCs Resources

The degree of ease to use a technology is captured in the literature of the UTAUT revised model's concept of effort expectancy for influencing behavioral intentions to adopt and use technology. Similar concepts are discovered in the datasets of this study and are built upon to further explore the research question. The concept is adjusted to the *characteristics of V&TCs resources* in relation to V&TCs technology. The emergent themes of the characteristics of V&TCs resources are the *qualities* and *drawbacks* of the V&TCs technology. The qualities and drawbacks of the V&TCs technology could play a role in humanitarian organization's adoption and use of the V&TCs technology. The qualities signify the characteristics of V&TCs resources that appear to be beneficial and motivate humanitarian organizations to adopt and use the technology. Meanwhile, the drawbacks refer to the characteristics of V&TCs resources' limitations in the technology, which seem to deter humanitarian organizations in adopting and using the V&TCs technology. The likelihood of a humanitarian organization to adopt and use V&TCs are greater when the qualities are more substantial than the drawback characteristics of V&TCs resources.

In terms of V&TCs, each one is very technical, and the resources offered from V&TCs to V&TCs varies. For this reason, within the Central Sulawesi disaster response, the resources generated differ in qualities and drawbacks. The two identified V&TCs used and discussed the most in the Central Sulawesi disaster are SBTF and HOT, which will be discussed in turns below as to their respective qualities and drawbacks.

The resources SBTF provided in the disaster response has both qualities and drawbacks. Some of the beneficial attributes of SBTF are for example, how it offered a service for organizations to make specific requests for what they need and tried to make sure somebody is available 24 hours (SBTF, personal communication, November 21, 2018). SBTF tried to ensure that their actions matched the activators' needs, by looking at different kinds of information and what could be done with it (SBTF, personal communication, November 21, 2018). Based on the request SBTF received, it can also produce exclusive resources for particular organizational uses, such as the

activation requested from the association of Indonesian journalists. SBTF specifically focuses on producing precise data, instead of focusing on an appealing display of resources (SBTF, personal communication, November 21, 2018). Another quality of SBTF is how the activator is given a live link fairly early, so the user can have access to preliminary information instead of waiting until the final resource is produced (SBTF, personal communication, November 21, 2018). Lastly, SBTF is also very careful about not putting personal identifiable information in their resources accidentally.

However, there are drawbacks with SBTF resources. The information included in the SBTF resources are limited to what exists digitally, while consequently information that is not produced digitally cannot be found (SBTF, personal communication, November 21, 2018). This suggests restrictions within the data being used, as some people did not have access to platforms such as Twitter, and Facebook to upload their information (SBTF, personal communication, November 21, 2018). Another main problem is how lots of communication happened on private pages, which also could not be observed or used. SBTF tried to be as inclusive as possible and is aware of what information is missing, as well as what can be exactly stated from it (SBTF, personal communication, November 21, 2018). In addition, it was difficult for the volunteers to interpret some of the acronyms and phrases used, since people on social media (for instance on Twitter and Instagram) converse in shorthand which is a challenge to read unless one speaks Malaysian and is in the same social group and age (SBTF, personal communication, November 21, 2018). Despite these constricting characteristics, the SBTF received positive feedback since the available information was discovered and provided supplementary information for the users requesting the information.

Similarly, qualities and drawbacks were discovered in the resources made available by HOT in the disaster response. HOT is an initiative that prepares data that is ready and usable for humanitarian organizations (HOT, personal communication, November 29, 2018). According to HOT (personal communication, November 29, 2018),

> "if there is an area affected by disaster our team makes an initiative to map that area sometimes before the government asks for our assistance. Later we can share, and the data is ready for them to use. I mean even sometimes the international organizations also already use HOT data before we offer the data to them."

HOT provided free maps with spatial data, that are open to everyone to access, benefit from the details, and contribute to the mapping (HOT, personal communication, November 29, 2018). The application also works on mobiles, which enables everyone who is in the field at the time, to input and contribute information directly to the mapping (UNFPA, personal communication, November 20, 2018). OSM, which HOT is based on, maps all the buildings, individual building footprints, and road maps (HOT, personal communication, November 29, 2018). Since different organizations have their own way to officialize data with their specific needs, HOT only provides the data instead of adding visualization aids to not disrupt the data (HOT, personal communication, November 29, 2018). UNFPA stated, that during the disaster it is difficult to get updated data, but the HOT maps are very useful, easy to retrieve, and verified (personal communication, November 20, 2018). "It is very helpful for us in the field. So, we get the updated conditions of the road, the tunnel area, geo locations, it's very updated. Because you know the land is changing a lot (UNFPA, personal communication, November 20, 2018)." In addition, REACH identified that there is added value in having the updated and complete pre-disaster coverage from the OSM dataset, as it is "a very good proxy for total building count for administrative area, and then you can assign a population value based on that. That gives you a very important matrix to cross check against" (personal communication, December 5, 2018).

Nonetheless, characteristics of the HOT resources include drawbacks as well. In Palu, HOT was quite successful in providing baseline data, but it also had limitations, such as not delivering damage estimation. HOT could not provide the information, because the conditions on the ground did not allow direct data collection and there was a lack of cooperation a local partner, who might have gathered such data (HOT, personal communication, November 29, 2018). CARE International indicated that the map's weakness is aerial imagery, as it lacked details from the surface level which makes it a challenge to identify what is being displayed (personal communication, November 19, 2018). It was also stated that the graphics of the maps do not assist in certain decision-making tasks, since there is no context with the information (UNICEF, personal communication, November 29, 2018). For example, when thinking critically about the maps, "what is actually happening in [a] camp with 500 people, what is happening in camps with 120 persons?" and "what can we see with this map? Do people have the capacity to understand how they should read the maps? How they should treat this infographic information (UNICEF, personal

communication, November 29, 2018)?" Lastly, it is noted that HOT could be more user-friendly with the addition of narratives (UNFPA, personal communication, November 20, 2018).

6.3 Perceived Importance of V&TCs Technology

The extent of the perceived importance of a technology by others for an individual to use such technology is explained in the literature of the UTAUT revised model's social influence construct. Aspects of this theme are presented in the dataset, as patterns led to the reconceptualized theme of *perceived importance of V&TCs technology*. The main feature of this theme is the humanitarian organization's interest levels in adopting and using the V&TCs technology. The theme interest level is divided into two categories: *high* and *low*. High interest levels refer to excitement, motivation, value, and the intent to use the V&TCs technology. In contrast, low interest levels signify minimum enthusiasm, lack of motivation, little value, and slight to no intent to use the V&TCs technology. As such, the higher the humanitarian organization's interest level, the more likely it will adopt and use the V&TCs technology; and the lower the humanitarian organization's interest level, the less likely it will adopt and use the V&TCs technology.

The findings for the perceived importance of V&TCs technology are mixed with both high and low interest levels in adopting and using the V&TCs technology. First, after Haiti 2010, there was a large interest and hype in V&TCs (Information Management Consultant, personal communication, December 3, 2018). "It is really interesting what these digital volunteers can do in a humanitarian context" (Humanitarian worker, personal communication, November 30, 2018). It also triggered the thought of working with other enterprise service architectures within humanitarian actions (Information Management Consultant, personal communication, December 3, 2018). According to REACH (personal communication, December 10, 2018), there is an increasing profile of OSM, as it is generally recognized that there is not a better data source. Despite the initial V&TCs hype fading a little bit, OSM datasets are present in virtually all country disaster responses (REACH, personal communication, December 10, 2018). Thus, there is a great deal of gratitude for OSM, and many clusters rely on their datasets for information such as points of interests, health facilities, and education facilities (HDX, personal communication, November 22, 2018).

However, humanitarian organizations also stated that there has been a bit of a decline in the use of V&TCs. The activation of V&TCs has led to a movement towards more internally specialized services, by having a larger capacity in organizations (Information Management Consultant, personal communication, December 3, 2018). For example, the European response coordination center supported by the joint research council has the Copernicus satellite readily available to move over an area as needed (Information Management Consultant, personal communication, December 3, 2018). Next, there is also a trend to localize activities; since there are people in Indonesia who can speak the language, and are more familiar with the land, networks, people, local contacts, and culture (Information Management Consultant, personal communication, December 3, 2018). Humanitarian organizations are starting to question the impact of V&TCs, how often it is being used, the meaning of the data, and remote work versus local work (Information Management Consultant, personal communication, December 3, 2018). Based on some past negative examples, as indicated in some of the above sections, humanitarian organizations are also more cautious (REACH, personal communication, December 10, 2018). Furthermore, there is more active thinking and a realization now that there is not much to be found in a disaster online, and more can be learned in the field by talking to people (Information Management Consultant, personal communication, December 3, 2018).

6.4 Organizational Support

Within the adoption and use of technology, the construct facilitating conditions is an important area to focus on, according to the UTAUT revised model. It represents the degree of resources, knowledge, and support provided from an organization to use the technology. Similarities and differences are searched for within the data, which eventually focused the concept to *organizational support*. Organizational support refers to the training and development a humanitarian organization receives in technical support to effectively use V&TCs technology. The concept has one category: *training and development* (or the lack thereof). Training and development represent the actions of training humanitarian organization's technical skills to accurately use V&TCs technology. While the lack of training means inadequate action to prepare and deliver a tutorial on technical skills for a humanitarian organization to accurately use V&TCs technology. The more training and development a humanitarian organization received, the greater the probability it may adopt and use the V&TCs technology. If a humanitarian

organization receive minimal to no training on technical skills for the usage of V&TCs technology, it may not adopt or use the V&TCs technology.

Information on organizational support discovered in the dataset shows that training and development support is provided for humanitarian organizations. HOT explained, that HOT Indonesia's goal is to have preparedness activities to train humanitarian organizations before becoming involved or directly part of the disaster response (personal communication, November 29, 2018). This training sessions from HOT involved the following explanations:

> how to use the data; "what part of the tools are available if they want to download the data for a particular area and then how to do that; what are the limitations; and what are the benefits that they can use out of that data. We also assist them on how to do filters and collection on the ground; as well as how they want to add their own data into OpenStreetMap platform; what is the standardization that they can use; what types of tags; and what types of data that can and cannot be added to OpenStreetMap." (HOT, personal communication, November 29, 2018)

The relationship between the humanitarian organizations and HOT has existed since 2012, so humanitarian organizations are aware of HOT's services (HDX, personal communication, November 22, 2018). Many training sessions have been conducted by HOT for actors such as government officials, NGOs, some private sectors, the Red Cross community (HDX, personal communication, November 22, 2018). The humanitarian organization UNFPA has also delivered training tutorials on HOT for people managing data to know how to read the maps, how to understand special data, how to map with standards in a special format, and other information along those lines (UNFPA, personal communication, November 20, 2018). Moreover, it is stated that "as long as you understand how to read maps. I think everyone can use it, but of course if you want to do interpretations or more detailed analysis, they have to have understanding on the special data for that" (UNFPA, personal communication, November 20, 2018).

6.5 Trust

The extent to which a person has confidence in the capacity and performance of a technology is stated to be a significant factor in the adoption and use of technology in the UTAUT revised

model's construct of trust. This construct is identified in the dataset, and repeatedly referred to with ideas associated to beneficial technology, useful technology, relationships, and working together. As a result, the construct of *trust* is redefined to include two subthemes: *technology competence* and *working relationship*. Technology competence represents the humanitarian organization's trust in the V&TCs technology proficiency, abilities, and performance. Working relationship refers to the humanitarian organization's trust in the relationship with the V&TCs, i.e. their behavior towards each other. When the technology competence and working relationship are positive, rather than negative, the humanitarian organization is possibly more willing to adopt and use the V&TCs technology.

The humanitarian organizations stated trust in the V&TCs technology is mostly positive. HOT stated that the V&TCs was launched in Indonesia around 2011, and it was not well known since the data was very low (personal communication, November 29, 2018). For example, "we only had around 30,000 of buildings all over Indonesia that were already mapped in OSM, which is a very low number for a country with 270 or 260 million people living there" (HOT, personal communication, November 29, 2018). It has taken HOT some time to build that trust with humanitarian organizations and the government, as the potential of the data availability needed to be understood (HOT, personal communication, November 29, 2018). Despite there being situations where the information is not exactly correct and there being a need to having to validate the data in the field, UNFPA finds OSM's information very useful in such cases (UNFPA, personal communication, November 20, 2018). UNFPA has never experienced a circumstance where the incorrect data has made the situation worse (UNFPA, personal communication, November 20, 2018). When humanitarian organizations first started using V&TCs technology, there was a certain level of unpredictability, as some V&TCs would get halfway through a project and then went to do something else (UNOCHA, personal communication, December 10, 2018). UNOCHA explained, "I think it's a much more predictability in terms of how we quo pro each other and certainly seeing that with you know OpenStreetMap here [Indonesia], and others. I think just the fact that the capacity is pretty much always there" (personal communication, December 10, 2018). In addition, when V&TCs are able to explain how they received their data, it can be traced to test the trustworthiness of the information (Information Management Consultant, personal communication, December 3, 2018).

Trust for humanitarian organizations' working relationship with V&TCs is mixed. A large portion of disaster response depends on relationships and knowing the people in the field, as it is a fairly small community (Information Management Consultant, personal communication, December 3, 2018). UNOCHA stated, "we are in a much better place than we were, but we are nowhere near where we could be, in terms of relationships going forward and that will take some work. It's interesting. It'll take some work" (personal communication, December 10, 2018). The potential with V&TCs is substantial, but "the connectivity, the relations, and then the way of people thinking is still not there" (HDX, personal communication, November 22, 2018). There are also not enough resources available to sit down and have the necessary conversations with V&TCs, which makes the ability to advance much slower (UNOCHA, personal communication, December 10, 2018). For instance, "humanitarians spend 95% of their time responding, and 5% of their time planning for response" (UNOCHA, personal communication, December 10, 2018). Additionally, when a relationship with a V&TCs is established for a long time, the humanitarian organization already knows what data will be collected and where it will be sent (HDX, personal communication, November 22, 2018). In succession, it makes communication easy and informal (HDX, personal communication, November 22, 2018). For example, in Indonesia, "OSM has been recognized by the government in Indonesia as one of the tools that they use during the crisis of emergencies", as OSM built-trust overtime and is reliable (HDX, personal communication, November 22, 2018).

6.6 Mutual Awareness

Through closely examining the dataset, a concept is formalized by connecting pieces of data and recognizing regularities in making a significant link to an emergent theme- *mutual awareness*. The theme mutual awareness refers to humanitarian organizations and V&TCs understanding of each other's organizational cultures and needs in order to perform successful disaster response activities within the humanitarian sector. The theme is identified in the data with information corresponding to descriptions on organizational culture, comprehension of the sectoral context and issues, and awareness of internal and external needs. The concept suggests that a greater understanding of, and between humanitarian organizations and V&TCs, increases the probability for a humanitarian organization to adopt and use V&TCs technology.

The findings suggest that further understanding is needed for both humanitarian organizations and V&TCs, pertaining to each other's organizational cultures and needs. To start with, humanitarian organizations are used to working with very basic programs such as Excel spread, as it is still currently utilized to collect information on the 3Ws (HDX, personal communication, November 22, 2018). Apart from the major institutions, most humanitarian organizations do not understand what is possible with V&TCs (UNOCHA, personal communication, December 10, 2018). For example, HDX stated "STBF is a very good resource. It is just sometimes people tend to not realize the capacity and the resources they will get" (HDX, personal communication, November 22, 2018). As such, humanitarian organizations' disaster responders' awareness and the ability of outsourcing, instead of doing everything themselves, needs to grow (Information Management Consultant, personal communication, December 3, 2018). The culture of humanitarian organizations is shifting towards a slightly less regulated standpoint, excluding certain areas that makes them nervous such as data privacy (UNOCHA, personal communication, December 10, 2018). Humanitarian organizations are only encouraging and suggesting standards for V&TCs to use, instead of trying to force the issue (UNOCHA, personal communication, December 10, 2018).

When V&TCs were first introduced, humanitarian organizations preferred to dictate what information was needed from the V&TCs; however, humanitarian organizations now prefer having all the data V&TCs collect, as the data is now cleaned by some humanitarian organizations themselves (UNOCHA, personal communication, December 10, 2018). Nonetheless, it is still important for V&TCs to remember the 3Ws assessment and to address the most valuable information for humanitarian organizations in the field: 'what is missing' and 'what people are doing' (Information Management Consultant, personal communication, December 3, 2018). The difficulty for the humanitarian organizations is figuring out 'what information is missing' (Information Management Consultant, personal communication, December 3, 2018). In addition, during a disaster response, humanitarian organizations require very quick and effective communication, as maintaining a dialogue takes too much time (Information Management Consultant, personal communication, December 3, 2018). HOT Indonesia is extremely well organized, but it is very difficult to communicate in other countries such as Bangladesh (REACH, personal communication, December 10, 2018). Communication needs to merely include a clear

scope and end goal, and feedback (Information Management Consultant, personal communication, December 3, 2018).

For V&TCs, the majority of the organizations are free of charge, consist of volunteers with an interest in disaster response, and assist in humanitarian efforts. For example, the SBTF consists of volunteers with diverse professional backgrounds, who have a desire to help in particular events and learn about emergency management (SBTF, personal communication, November 21, 2018). Meanwhile, community volunteers mostly collect data for OSM, which is frequently used by the Government of Indonesia and humanitarian agencies (HDX, personal communication, November 22, 2018). These different V&TCs have a relationship with each other, and in some ways complement one another, while they collaborate and perform slightly different services (SBTF, personal communication, November 21, 2018). However, V&TCs are still developing in their level of sophistication, and some initiatives have not fully established procedures such as how to evaluate success with key performance indicators (SBTF, personal communication, November 21, 2018). There are also varying standards and levels of how humanitarian principles are incorporated in V&TCs; for instance, HOT is the most transparent with its opensource platform that allows everyone to access the data (HOT, personal communication, November 29, 2018).

Coupled with V&TCs individual growth, the entire community is developing. Tensions exists on whether V&TCs should continue creating huge amounts of data that overlap between volunteer groups, or to use a more structured system which determines who is doing what, and where (SBTF, personal communication, November 21, 2018). Some V&TCs also need to address the lack of accountability when relying on a crowd and volunteers, since it can be difficult to create commitment for completing an entire task (REACH, personal communication, December 10, 2018). It is also noted that V&TCs need to increase their capacity of understanding what humanitarian organizations need, how humanitarian organizations read the information as well as information quality, and how collected data helps humanitarian organizations in making a decision (UNICEF, personal communication, November 29, 2018). Thus, to strengthen this mutual awareness between V&TCs and humanitarian organizations, V&TCs need to be open to receive feedback to move forward (REACH, personal communication, December 10, 2018).

6.7 Cultivating Better Cohesion

During the process of examining the dataset, another new concept is brought together into a theme, labelled here as *cultivating better cohesion*. The identified emergent theme of cultivating better cohesion represents actions to improve the cooperation between two or more organizations striving to attain a shared humanitarian goal. The concept is identified in the dataset with ideas associated to communication, teamwork, relationships, collaboration, and awareness. Subsequently, the concept is divided into two subthemes: *communication* and *teamwork*. Communication refers to the exchange of information between V&TCs and humanitarian organizations. Teamwork represents the combined actions of V&TCs and humanitarian organizations to perform a task cohesively and effectively. Accordingly, cultivating better cohesion between humanitarian organizations and V&TCs through their communication and teamwork may increase the use of V&TCs technology.

The findings for cultivating better cohesion indicated that collaboration between humanitarian organizations and V&TCs exists, and current communication and teamwork approaches can be improved. Communication with V&TCs is critical for facilitating the flow of ideas with humanitarian organizations. For HOT Indonesia, it has direct communication with the Government of Indonesia's BNBP for opening the national platform to allow people to contribute in mapping Central Sulawesi's affected areas (UNFPA, personal communication, November 20, 2018). Meanwhile, the SBTF offers 24 hours availability a day for activations and activators to contact its core team, as its team members reside across six different time zones, (SBTF, personal communication, November 21, 2018). The core team of SBTF also maintains internal communication continually through 'Slack', a cloud-based tool to ease teamwork (SBTF, personal communication, November 21, 2018). Since the tools to conduct communication are expanding and moving fast, it has led to difficulties in maintaining a disciplined approach to data management (UNOCHA, personal communication, December 10, 2018). For example, in the Central Sulawesi disaster response, lots of data, such as meeting minutes and spreadsheets of data were lost in the chat application WhatsApp (UNOCHA, personal communication, December 10, 2018). UNOCHA explained, that in the earthquake response of Aceh in 2016, its "WhatsApp group which lasted about 2.5 weeks, printed about 105 pages of A4 papers size 8 fonts close typed" (personal

communication, December 10, 2018). Thus, the development of communication between V&TCs and humanitarian organizations, should be aware of these weaknesses.

The cooperative efforts of teamwork between V&TCs and humanitarian organizations is not fully developed. During large disasters and emergency preparedness, HOT is frequently used in Indonesia for mapping (UNFPA, personal communication, November 20, 2018), since BNBP recognized the usefulness of HOT as an emergency tool (HDX, personal communication, November 22, 2018). The relationship between BNBP and HOT has been established for many years and is building knowledge on how OSM tasking managers responding to a disaster collect certain data and send it to HDX's platform (HDX, personal communication, November 22, 2018). With this connectivity it is reasonably easy to progress forward, as both organizations are familiar with each other's capabilities and work (HDX, personal communication, November 22, 2018). However, within the Southeast Asia region it is understood that only one HOT OSM office exists in Indonesia. For Indonesia this is beneficial, as HOT OSM has a high team capacity that is able to help in medium scale emergencies, where outsider assistance is low (HDX, personal communication, November 22, 2018). The localization of HOT OSM makes it easier because communication is through one data manager that is flexible, well-understood, and trained on "how usually things work, or what kind of sources of mechanism in terms of data varying, data quality" (HDX, personal communication, November 22, 2018). As a result, a data manager "know exactly what sort of language they need to talk or what sort of things need to ask, instead of asking too many questions. This can really be short discussion" (HDX, personal communication, November 22, 2018).

To develop a good sense of teamwork, humanitarian organizations need to know each other and the point of contact of other organizations. This usually happens during prior disasters that occur in Indonesia, meetings, or workshops (HOT, personal communication, November 29, 2018). Through building a working relationship, a humanitarian organization understands the V&TCs abilities and its contact's capabilities (Information Management Consultant, personal communication, December 3, 2018). UNOCHA stated, "we work through the establishment of personal relationships through the greater mutual understanding of objectives of systems of safeguards and so on and so forth." (personal communication, December 10, 2018). When the

people with these relationships are physically present during a disaster, they are able to zoom out and connect ‘what people in the field are looking for’ with ‘what is possible’ outside the immediate emergency effort’s traditional field kit (Information Management Consultant, personal communication, December 3, 2018). Followingly, feedback is needed on both sides, especially for V&TCs to know whether their efforts are useful (Information Management Consultant, personal communication, December 3, 2018).

7. Discussion

This study’s findings conveyed large amounts of relevant data pertaining to how humanitarian organizations responding to the September 2018 natural disaster in Central Sulawesi, Indonesia adopted and used crowdsourced data applications developed by V&TCs. A large amount of information was discovered, which provided significant answers for the research question. Additionally, the findings fit in with previous research conducted on humanitarian information management practices involving V&TCs. Therefore, this study offered further understanding, and illuminated new insights in humanitarian organizations’ information management practices adopting and using V&TCs.

A finding that determined the scope of this study was how the Government of Indonesia outlined specific regulations for international assistance in the September 2018 natural disaster in Central Sulawesi. This circumstance of foreign NGOs not being allowed to go directly to the field and having to conduct activities in partnership with local partners (BNBP, 2018), most likely affected which V&TCs participated in the disaster response. The number of V&TCs used were limited, and only two V&TCs were interviewed for the purpose of this study (SBTF, and HOT). The majority of the research project’s information on V&TCs was focused on HOT, since BNBP has recognized HOT as a useful tool to assist in Indonesia’s emergency response activities (HOT, personal communication, November 29, 2018). This showed that BNBP has adopted HOT and used it repeatedly, considering Indonesia’s disaster-prone status. In turn, this may affect the adoption and use of V&TCs in humanitarian organizations, as the disaster struck country essentially determined which V&TCs could be activated. Therefore, if the regulated use of localized humanitarian assistance happens more frequently, then the adoption and use of V&TCs may only move forward with more established V&TCs that are registered in multiple locations.

7.1 Perceptions of V&TCs Technology

This study presented humanitarian organizations' perceptions of V&TCs technology as a key finding. As previously stated, this concept was similar to the UTAUT's revised model's construct of performance expectancy (a person's belief that the technology will increase their job performance) (Venkatesh et al., 2003). However, the concept changed to 'perceptions of V&TCs technology' and concentrated on humanitarian organizations' prior experiences of actually using the V&TC technology and its relevance for the tasks being performed during the disaster response. The findings indicated a stronger relationship between the perceptions of V&TCs technology and the adoption and use of V&TCs technology. Each of the humanitarian organizations that stated positive prior experiences and found the V&TC technology relevant for their tasks, confirmed they will use HOT again (e.g. UNFPA, Humanitarian Worker, UNOCHA, and HDX).

Next, a humanitarian organization stated a mixture of previous experiences with V&TC technology as both positive and negative, but in any case, found it useful for the humanitarian organization's mapping tasks and affirmed it would continue using the V&TCs technology (REACH, personal communication, December 10, 2018). The negative previous experience for the humanitarian organization was shown to be associated to the difficulty of productively engaging with HOT. Accordingly, this was related to Van Gorp's barrier (2014) of humanitarian organizations' usage of V&TCs technology being affected by the limited availability of V&TC staff. In addition, a humanitarian organization expressed a negative perception of V&TCs technology, which was related to how the V&TCs technology was not relevant for its tasks, that influenced its decision to not use the V&TCs technology (UNICEF, personal communication, November 29, 2018). Therefore, the relevance of the humanitarian organizations' tasks substantially affected its perception of the V&TCs technology, and whether it intended to adopt or use the V&TCs technology. Overall, most of the humanitarian organizations encountered positive prior experiences with V&TCs technology; and humanitarian organizations found V&TCs relevant as well as useful for the tasks performed in the disaster response for Central, Sulawesi, Indonesia.

Furthermore, the research study found that humanitarian organizations predominately used V&TC technology for crisis mapping, which is similar to the study conducted by Van Gorp (2014). The

findings also reported humanitarian organizations' listing prior experiences with V&TCs technology associated to almost exclusively crisis mapping. These examples consisted of the following disasters: Bangladesh 2017, Haiti earthquake, Chile earthquake, Libya crisis, and Haiyan typhoon in the Philippines. As such, it is shown that V&TCs technology tends to have a significant role in crisis mapping during disaster response situations for humanitarian organizations. Correspondingly, as already suggested by Anhorn, de Albuquerque, & Herfort (2016), it was found that V&TCs crisis maps were detailed and consisted of helpful information such as individual building footprints, roads, and walkways. The findings stated repeatedly that the V&TCs HOT was a valuable resource, which provided what was considered as an incredibly important matrix to cross check against (REACH, personal communication, December 10, 2018). The crisis maps also showed particularly relevant data for the humanitarian information management logistic cluster, as it played a role in understanding and planning routes (HOT, personal communication, November 29, 2018). Therefore, the findings indicated that HOT's crisis maps were the most detailed and helpful maps readily available, which contributed to the humanitarian organizations likelihood of adopting and using the V&TCs technology in the event of another disaster response in Indonesia.

7.2 Characteristics of V&TCs Resources

The research findings showed that the characteristics of V&TCs resources (qualities and drawbacks) were particularly important in how humanitarian organizations adopted and used V&TCs technology. As outlined earlier, the concept of characteristics of V&TCs resources was initially drawn from the UTAUT revised model's construct of effort expectancy (the extent of ease to use a technology); and it was altered to better match the adoption as well as use of V&TCs technology in the Central Sulawesi, Indonesia disaster response. The qualities and drawbacks of the characteristics of V&TCs resources provided evidence for a greater relationship with humanitarian organizations' adoption and use of V&TCs technology, than the UTAUT revised model's construct of effort expectancy. In general, this study found that the characteristics of V&TCs resources contained more qualities than drawbacks. As the findings' qualities are more substantial, these findings may suggest that humanitarian organizations are more likely to adopt and use V&TCs technology by SBTF and HOT. However, one humanitarian organization placed a great deal of importance on the significance of a drawback characteristic of V&TCs resource,

which affected its intention to adopt and use the V&TCs technology. Therefore, the frequency and significance of the characteristics of V&TCs resources could be attributed to humanitarian organizations adoption and use of V&TCs technology.

This study further found that V&TCs technology qualities and drawbacks vary from V&TCs to V&TCs. The findings showed SBTF offered many services (crisis-maps, information gathering, reports on the 3Ws, and remote assessment) (SBTF, n.d.), and HOT provided a singular service of crisis mapping. It is interesting to note that the two V&TCs used in this study shared common qualities: humanitarian organizations had around-the-clock availability to the resources; V&TCs focused on delivering precise data instead of visually appealing aids; and V&TCs incorporated some humanitarian principles within their services (e.g. inclusiveness, confidentiality, and transparency). The findings of the V&TCs incorporating humanitarian principles were consistent with the Global Symposium +5 principles of the technology elements needing to include humanitarian principles for best practices, as previously stated by UNOG (2008). Similarly, the findings also revealed that HOT and SBTF had a common drawback: limitations to what information existed digitally (e.g. HOT lacking details from aerial imagery, and SBTF's inability to collect data from people who did not produce digital data). Therefore, it seems that information from V&TCs could be a major factor in the process of developing accurate situational awareness after a disaster, but on the ground field information is still required.

Additionally, one of the issues that emerged from the findings was how the HOT crisis maps did not assist in certain decision-making tasks (UNICEF, personal communication, November 29, 2018). This finding may help to understand the expectations of humanitarian organizations, plus emphasized the need to explain to humanitarian organizations the limitations of V&TCs resources as it cannot provide a solution for all disaster response tasks. This finding corroborates the ideas of Van Gorp (2014), who suggested that humanitarian organizations have limited knowledge about V&TCs expertise. This is important since the issue affected the humanitarian organizations' adoption and use of the V&TCs. As a result, humanitarian organizations' adoption and use of V&TCs can be improved by addressing the drawbacks presented from the study's findings: explaining to humanitarian organizations what information the V&TCs technology contains, the

limitations of the V&TCs technology, and suggesting the disaster response tasks that it could assist.

7.3 Perceived Importance of V&TCs Technology

The perceived importance of V&TCs technology was suggested to be vital to determine whether a humanitarian organization adopted and used V&TCs technology. As mentioned in the findings, the UTAUT revised model's construct of social influence (the degree of the perceived importance of others for an individual to use the technology) was used and changed to the perceived importance of V&TCs technology. The new concept was found to represent more accurately the adoption as well as use of V&TCs technology in the disaster response of Central Sulawesi, Indonesia. The research findings identified the perceived importance of V&TCs technology in terms of high or low importance. The findings that emerged from the perceived importance of V&TCs technology analysis were, however, mixed. The findings revealed new insight into V&TCs technology, as it was speculated that the increased interest in V&TCs by humanitarian organizations might be due to a technological hype cycle. The technological hype cycle was probably associated to the intense promotion of V&TCs after the 2010 Haiti earthquake, which launched immense interest pertaining to the possibilities of V&TCs technology within humanitarian disaster response. After the initial excitement, humanitarian organizations' interest in V&TCs reached a peak point of what V&TCs technology could achieve through V&TCs technology. Then, humanitarian organizations' interests started to decrease (Information Management Consultant, personal communication, December 3, 2018), and it may be assumed that this has been due to some V&TCs experiences perhaps not having delivered the assumed results. Accordingly, those V&TCs, which had been held to be producing a beneficial resource for humanitarian organizations, continued to deliver their services, while other less useful V&TCs possibly dissolved. Therefore, almost a decade later, V&TCs technology has started to become more stable, and established V&TCs (such as SBTF and HOT OSM) with beneficial technological resources are being used to help with certain humanitarian organizations' tasks. The results of this study matched the trajectory of a technological hype cycle, as the two V&TCs used in the case study were more established. Furthermore, humanitarian organizations do not have the staffing capacity to perform similar actions such as HOT's baseline mapping or SBTF's immediate services performed by hundreds of volunteers.

The presented findings for the perceived importance of V&TCs technology appeared to align with a possible V&TCs technological hype cycle. As stated by REACH, HOT OSM has an increasing profile, as there is no better baseline data source (personal communication, December 10, 2018). The presence of HOT OSM has grown and become known to many humanitarian organizations. With limited employees, a humanitarian organization cannot produce the type of information HOT delivers, as its network of volunteers has people with varying skills that could contribute and build a map. As a result, humanitarian organizations have mostly adopted and used HOT to leverage its data in Indonesia. Coupled with the technological hype, the in some cases perceived low importance of V&TCs technology was also attributed to internal specialization. The rise of V&TCs enlightened humanitarian organizations of the importance of data management and the skills that could be internally conducted. These were absorbed and converted into new jobs within humanitarian organizations (Information Management Consultant, personal communication, December 3, 2018). Thus, V&TCs technology augmented humanitarian organizations information management. Moreover, this new insight revealed that as the capacity and relevance of established V&TCs (e.g. HOT and SBTF) likely becomes more mainstream, humanitarian organizations may increasingly adopt and use established V&TCs technology.

7.4 Organizational Support

This study has shown that organizational support was essential for the adoption and use of V&TCs by humanitarian organizations. As stated beforehand, based on the UTAUT revised model's construct of facilitating conditions (the extent to which a user believes that the necessary resources, knowledge, and support have been given to assist them in using the technology), the concept was shaped to organizational support in an effort to better capture the research study's findings. The training and development provided to a humanitarian organization presented better evidence for organizational support than the UTAUT revised model's construct of facilitating conditions. The most obvious finding to emerge from this study was that better training and staff development most likely increased a humanitarian organization's adoption and use of V&TCs technology.

It was shown that V&TCs and other humanitarian organizations, such as UNFPA, provided training and development for humanitarian organizations on V&TCs technology. The evidence

from this study confirmed that resources were used to train humanitarian organizations during emergency preparedness activities (HOT, personal communication, November 29, 2018). When taking into consideration that humanitarian organizations only spend 5% of their time preparing for disasters (UNOCHA, personal communication, December 10, 2018) and as investment in disaster information processing tools remains low for humanitarian organizations (Van Gorp, 2014), it is vital for training and development activities to be as effective and efficient as possible.

The current HOT training and development sessions involved learning on the following: available downloadable functions; limitations, benefits from the data; filters; data collection methods in the field; use of standardizations; types of tags; and types of data added and what data cannot be added. As this study's findings indicate, the training and development was informative. However, it was somewhat surprising that the technical V&TCs did not use a digital teaching program for their training and development on the V&TCs technology. Traditional training sessions currently being delivered are not replicable or scalable, as this type of training is expensive, consumes valuable time, and limits the learning to the humanitarian organizations' physical presence at the location. A digital teaching program would require the eLearning tool to be created one time, and it could reach all the necessary humanitarian organizations with one-click of a button. The digital learning program could also be specifically tailored to a humanitarian organization's anticipated needs for their disaster response roles. Furthermore, this training tool would present the additional benefits of saving time (convenient and flexible), widespread connection and standardization (between V&TCs and humanitarian organizations), community building (social learning), reduced costs (cut out facilitator and travel costs), and accessibility (always available). Given the unstable context of humanitarian aid, the saved training tutorials' accessibility would be helpful since the environment of the target group is rather unpredictable. Therefore, further work is required to improve the training and development tools for humanitarian organizations, which would likely increase the adoption and use of V&TCs technology.

7.5 Trust

As stated in the findings, the UTAUT revised model's construct of trust (the degree to which a person has confidence in the competence and performance of a technology) was redefined to better fit the current research study's dataset. The concept of trust was derived from the life-work of the

research participants, which included the subthemes of technology competence and working relationship. The result of this study indicated that both the technology competence and working relationship affected the humanitarian organizations' trust level. The humanitarian organizations' trust in the V&TCs influenced the humanitarian organizations' behavioral intentions to adopt and use the V&TCs technology. This research study detected evidence for the humanitarian organizations' trust in the V&TCs technology competence as mostly positive; and the humanitarian organizations' trust with the V&TCs working relationship as mixed. Overall, the analysis of the humanitarian organizations' trust in V&TCs was more positive than negative, which increased the likelihood of a humanitarian organization to adopt and use V&TCs technology.

The V&TCs, and in particular HOT, provided the largest set of significant information on humanitarian organizations' trust in the V&TCs technology competence. The finding indicated that it took HOT a long time to develop a trust relationship with humanitarian organizations and the government of Indonesia (HOT, personal communication, November 29, 2018). HOT was established in Indonesia in 2011 and had to demonstrate as well as verify the potential of the data availability created by the V&TCs technology (personal communication, November 29, 2018). The findings suggested that V&TCs technology needed to show its track record for past successes and failures in order for the humanitarian organizations to determine how well the V&TCs technology will likely perform in the future. By providing the V&TCs technology track record and transparent data, it was able to build technology competency trust with humanitarian organizations and the government of Indonesia. The most interesting finding was how UNFPA never witnessed a situation where HOT's incorrect data made the situation worse, as it corroborates that HOT is supporting humanitarian principles with those emphasized by Sandvik et al. (2017, p.5): the "do no harm" principles of how humanitarian actions must "avoid exposing people to further harm as a result of your actions." Another important finding was how V&TCs technology competency improved overtime, and additional success stories of the V&TCs will likely increase the adoption and use of V&TCs technology.

With regard to the question of the humanitarian organizations' trust on working relationship, this study found support for both positive and negative findings. The findings indicated that

humanitarian organizations' trust in their working relationship with V&TCs has improved, but more can be done (UNOCHA, personal communication, December 10, 2018). Another finding further supported this idea, as the connectivity and relations were still not quite established (HDX, personal communication, November 22, 2018). In addition, the findings indicated a large part of disaster responses were based on relationships and knowing people in the field, which suggested an area requiring further attention. Since V&TCs predominantly work remotely, it seems that V&TCs lack a physical presence in the field to further develop their relationships with humanitarian organizations. This finding has important implications for developing a V&TCs representative to actively participate in the field, while simultaneously building trustworthy working relationships. This would allow the rest of the V&TCs technology team to work remotely and deliver support for humanitarian organizations. Therefore, the humanitarian organizations' trust in their working relationship with V&TCs would likely increase, and the humanitarian organizations' likelihood to adopt and use the V&TCs technology may increase as well.

7.6 Mutual Awareness

The results of this study found the emergent theme of mutual awareness significant for humanitarian organizations' behavior in adopting and using V&TCs technology. The analysis indicated that mutual awareness was related to organizational cultures and needs. Hence, increased understanding of, and between humanitarian organizations and V&TCs, supported the likelihood for a humanitarian organization to adopt and use V&TCs technology. The results of this study indicated additional understanding was needed by both humanitarian organizations and V&TCs related to each other's organizational cultures and needs.

The findings showed that humanitarian organizations were only accustomed to working with basic software applications in disaster responses such as Excel spread sheet (HDX, personal communication, November 22, 2018). The differences in technological capabilities between humanitarian organizations and V&TCs was found to be vast, as V&TCs are known for their technical skills, but it also explained humanitarian organizations' need for supplementary technical abilities in disaster responses to avoid gaps in humanitarian relief actions (Van de Walle et al., 2009). In view of this finding, it is understandable that most humanitarian organizations do not comprehend the possibilities of V&TCs technology, with the exception of perhaps major

institutions (UNOCHA, personal communication, December 10, 2018). Humanitarian organizations' lack of technological understanding substantially decreases their adoption and use of V&TCs technology, as it probably limits their ability to grasp the full extent of the technology's benefits and challenges. As such, more awareness is needed for humanitarian organizations on V&TCs technologies' distributed work ability and capacity of having people around the world to support disaster responses. The findings showed that humanitarian organizations' rigid culture towards technology was shifting to a less regulated point of view in certain areas (UNOCHA, personal communication, December 10, 2018). This suggests an opening to properly expose and explain V&TCs technology to humanitarian organizations, which could be conducted virtually with a digital training component and/or physically in person at humanitarian aid networking events and conferences.

In addition, this study found that, as mentioned by Meier (2015), V&TCs volunteers are ready to provide insight on disaster response. The results also indicated that V&TCs are still developing and establishing their procedures. With this finding in mind, V&TCs should consider the audience of their resources and try to serve them best: for maximum adoption and use of the V&TCs technology. Such actions would most likely include incorporating established humanitarian principles that operations follow (Hilhorst & Schmiemann, 2002), since the significance of these principles are mentioned several times in this study. Another key finding was the tensions that exist within V&TCs on whether the volunteer community should remain open and continue creating huge amounts of data that overlap, or to shift towards a more structured system which determines who is doing what, and where (SBTF, personal communication, November 21, 2018). The last key finding was the V&TCs' need to increase their understanding of what humanitarian organizations need. Therefore, further work is suggested to establish this. It would be advantageous for both humanitarian organizations and V&TCs mutual awareness of each other's organizational cultures and needs, and most likely for the adoption and use of V&TCs technology.

7.7 Cultivating Better Cohesion

The current study found that cultivating better cohesion was significant for the adoption and use of V&TCs technology. The analysis indicated two subthemes for cultivating better cohesion: communication and teamwork. The findings showed beneficial communication and teamwork

supported the cultivation of better cohesion between humanitarian organizations and V&TCs. Correspondingly, the results of cultivating better cohesion detected evidence that collaboration between humanitarian organizations and V&TCs exists, and current communication and teamwork approaches can be improved.

In this study, communication between humanitarian organizations and V&TCs was crucial for the exchange of information. The findings discovered direct communication between HOT and the Government of Indonesia, which most likely supported the Government of Indonesia and successively humanitarian organizations' adoption and use of HOT. Another interesting finding was the SBTF's use of the digital communication platform called Slack. Slack allowed the SBTF volunteers in different time zones to maintain communication and transfer files quickly amongst members in the group. To increase cohesion within the entire V&TCs network, Slack, or similar platforms, may be a beneficial resource to connect V&TCs and answer quick questions from other digital humanitarians on how to improve humanitarian organizations' adoption and use of V&TCs technology. However, the findings showed that with communication tools developing quickly, it was difficult to maintain a disciplined approach to data management (UNOCHA, personal communication, December 10, 2018). Therefore, the findings indicated it was important to be cognizant of all the communication tool's benefits and weaknesses before the implementation phase within a disaster response. This is an important issue for the future.

In addition, the results of this analysis indicated that the teamwork between humanitarian organizations and V&TCs can be developed further. The study found that HOT was used repeatedly in Indonesia's emergency preparedness, and large disasters (UNFPA, personal communication, November 20, 2018). As mentioned by Van Gorp (2014), crisis mapping by V&TCs seems to be a main activation request. The findings indicated that the relationship between BNBP and HOT has been established for many years, and OSM tasking managers know what data to collect and send (HDX, personal communication, November 22, 2018). It seems possible that these results were due to HOT being physically located locally in Indonesia. The OSM tasking manager also appears to act as a representative for the V&TCs, which was previously described as a way to increase the adoption and use of V&TCs technology. This finding was significant, and other V&TCs should possibly refer to the OSM task manager role as a best-case scenario of a

V&TC representative. The HOT OSM task manager was located in the same country and worked with more or less the same people, which probably substantially increased its teamwork capacity. As such, other V&TCs teamwork could be improved with more permanent V&TCs staff and being physically present in disaster responses and emergency preparedness activities. This finding is in agreement with UNOG (2008) humanitarian principles which explained humanitarian assistance aims to strengthen local capacity to respond to the humanitarian needs in a disaster. Furthermore, the presented results on HOT Indonesia appear to be one of the best cases within the Southeast Asia region of humanitarian organizations' adopting and using V&TCs technology.

8. Conclusion

The present study has provided new insight on how V&TCs technology contributes to internal humanitarian information management approaches in the context of disaster responses; the findings of which may be used to advance the efficiency and effectiveness of humanitarian innovation in disaster responses. This study took into account case studies and experiences of humanitarian organizations and V&TCs pertaining to the adoption and use of V&TCs technology, with a particular emphasis on the use of two resources provided by V&TCs in the context of the September 2018 earthquake and tsunami in Indonesia. On the basis of this, the study answered the main research question: *How do humanitarian organizations responding to a disaster adopt and use crowdsourced data applications developed by Volunteer and Technical Communities?*

For the purpose of better structure and classification of the study's findings, the results of interviews with practitioners in the field were clustered into seven main themes, which are as follows: (1) perceptions of V&TCs technology; (2) characteristics of V&TCs resources; (3) perceived importance of V&TCs technology; (4) organizational support; (5) trust; (6) mutual awareness; (7) and cultivating better cohesion. The study identified that each of the seven main themes contributed to the humanitarian organizations' adoption and use of V&TCs technology in the Central Sulawesi, Indonesia disaster response on September 2018. From these main themes, key results were drawn to answer the aforementioned research question.

First, the relevance of the humanitarian organizations' tasks strongly affected their perception of the V&TCs technology, and their behavioral intention to adopt and use the V&TCs technology.

Second, limitations related to digitally available information regarding the scene of the ground in real-time, indicated that humanitarian organizations may adopt and use V&TCs technology for their situational awareness; however, on the ground field information is needed as well. Third, the results of this study matched the trajectory of a technological hype cycle, determining that major V&TCs are more established, the present point in time may be most beneficial for humanitarian organizations to adopt and use the V&TCs technology's improved practices. Fourth, the results suggested that with improved training and development (e.g. through a digital teaching program) humanitarian organizations' adoption and use of V&TCs technology may increase. Fifth, the findings showed that V&TCs were supporting humanitarian principles, which also may contribute to an increase of humanitarian organizations' adoption and use of V&TCs technology. Sixth, further understanding was needed by both humanitarian organizations and V&TCs of each other's organizational cultures and needs, for humanitarian organizations to improve the adoption and use of V&TCs technology. Lastly, the findings indicate that HOT Indonesia, as one of the two main resources provided by V&TCs in the present case study, actually seems to be one of the best-case scenarios, at least within the Southeast Asia region, of humanitarian organizations' adopting and using V&TCs technology. Overall, the body of knowledge used in this research study was appropriate, as it provided an in-depth examination of both humanitarian organizations' information management systems, and (their relationship with) V&TCs. Through the research study, the current body of knowledge was further expanded, and new information on how to improve the adoption and use of V&TCs technology by humanitarian organizations can be added to the literature domain of humanitarian information management.

Nevertheless, this research has limitations regarding the sample size and may further be affected by the snowball sampling selection bias. Due to time and resource constraints, only a small number of interviews were conducted, which limited the amount of data available for the analysis. In addition, since the sampling relied on participants' recommendations of other potential participants, the sampling may to some extent reflect a biased access of information and selection. The data collection was affected by the timing of data collection and participants' personal perceptions as well as experiences, which are susceptible to change over time. Lastly, the underrepresentation of humanitarian organizations and the semi-structured nature of interviews may have influenced the results, limiting the replicability of the research. It is

important to recognize how the limitations could have affected the study's findings and interpretations, and the research gaps can indicate areas for future research.

For future research, further exploration of how humanitarian organizations adopt and use V&TCs technology should be done to establish a greater degree of insight on comparisons among different types of organizations, and different countries. A natural progression of this work would be to analyze a worst-case scenario of humanitarian organizations adoption and use of V&TCs technology, and to then compare the respective findings with this study's results. It would further be of value to assess the effects of digital teaching programs (i.e. e-Learning tools) in the framework of humanitarian organizations' adoption and use of V&TCs technology. Therefore, this study has unwrapped many questions in need of further investigation.

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Appendix I: Interview Details

#	ORGANIZATION	TITLE	DATE OF INTERVIEW
1.	Care International	Knowledge & Data Management Reporting Specialist	November 19, 2018
2.	UNFPA	Special Advisor on Population Census and Humanitarian Data	November 20, 2018
3.	SBTF	Core Team	November 21, 2018
4.	HDX	Humanitarian Data Officer	November 22, 2018
5.	HOT OSM	Country Manager of Indonesia	November 29, 2018
6.	UNICEF	Child Protection Specialist	November 29, 2018
7.	Humanitarian Worker	Humanitarian Worker	November 29, 2018
8.	Consultant	Information Management Consultant	December 5, 2018
9.	REACH	Senior GIS Manager	December 10, 2018
10.	UNOCHA	Chief Officer of UNOCHA Indonesia	December 10, 2018

Appendix II: Codes

Super-ordinate theme	Emergent theme
1. Perceptions of V&TCs Technology	**Prior Experience:** *Benefits* Haiti WHO requested and received information the next morning; there is this whole big volunteer community out there that were keen and willing; working with V&TCs common sense; digital volunteers added value to the humanitarian response in the Chile earthquake; creating the Libya crisis online map reports for the security council meeting; in the Philippines, V&TCs made it possible to create a damage assessment in less than 6 hours. *Challenges* Bangladesh issues with the map's completeness and footpaths were incorrectly digitalized; challenge engage with HOT early on; REACH digitized building footprints. **Relevance for Tasks:** *Useful* OSM more detailed than Google Maps; OSM maps buildings, individual building footprints, and road maps; OSM's data is updated during the pre-disaster period; OSM very good proxy for total building count; helpful for logistic planning and understanding routes; OSM offers a common frame of reference; V&TCs technology possesses potential. *Unusable* Critical of the usefulness in information displayed; not enough information about the context; capacity to understand what is actually happening.
2. V&TC Platform Characteristics	**Qualities:** *SBTF* Service for organizations to make specific requests; somebody available 24 hours; actions matched the activators needs; nonpublic resources for particular organizational uses; precise data; live link; access preliminary information; very careful personal identifiable information. *HOT* Ready and usable; team makes an initiative to map affected areas; free maps with spatial data; open to everyone; input directly from the field; maps all the buildings, individual building footprints, and road maps; provides the undisrupted data; very useful, easy to retrieve, and verified; very updated; very good proxy for total building count for administrative area; matrix to cross check against.

	Drawbacks: *SBTF* Limited to what exists digitally; no access to platforms such as Twitter, and Facebook to upload information; communication in private pages; aware of what information is missing; hard understand acronyms and phrases. *HOT* Not delivering damage estimation; no local partner helping; weakness is aerial imagery; lacked details from the surface level; do not assist in certain decision- making tasks; think critically about the maps and how can be used; more user-friendly with the addition of narratives.
3. Perceived Importance of V&TCs Technology	**Interest levels:** *High* V&TCs has triggered the idea work with enterprise service architecture; OSM virtually all of the response countries; OSM increasing profile; Not a very good chance of anything better being out there from OSM; the hype to fade a little bit; clusters depends on getting most of their datasets, or points of interests, health facilities, education facilities through OSM; quite grateful OSM; really interesting. *Low* Hype; more than cautious because of some past experiences; bit of a decline; why would we do something externally when the people locally can do it?; they speak the language, know the lay of the lands, know the networks, know the people, know the local contacts and culture; integrated into an organization as an integral part; actively thinking about what technologies; Europe we have the European response coordination center supported by the joint research council who does analysis and mapping; Copernicus satellites; second trend is localization; there isn't that much to be found in a disaster; learn much more by being in the field and talking to people.
4. Organizational Support	**Support:** *Training and Development* Relations established in 2012; we know exactly what we get; do a lot of training I mean the OSM in Indonesia is quite active; everyone can use it; do interpretations or more detailed analysis so they have to have understanding on the special data; gave basic training; gave basic training in using special GIS, also like gave basic training *Lack of training* n/a

5. Trust	**Trust:** *Technology competence:* Takes quite some time to build that trust; Indonesia around 2011, and at this time we were still unknown; data was still very low in 2011; more making them understand the potential of the data its self; tell me how they've done it, I can retrace it; relationships, they are far more predictable; get half way through a project and they would go no we are going to do something else now; capacity is pretty much always there; number is not so correct; do like validation also from the field; at least we got the information; lot of potential, it is just the connectivity, the relations, and then the way of people thinking is still not there *Working relationship* Relationships, they are far more predictable; certain number of unpredictability at the start of this whole thing; they will collect data, and they will send; relations are already built since long time ago; really easy to basically communicate; OSM has been recognized by the government in Indonesia; without really need some sort of formal request; its built-on trust; disaster response is built on relationships and knowing somebody; Humanitarians spend 95% responding and 5% planning for response; don't have the resources makes those sorts of discussions; ability to advance much slower; nowhere near where we could be

Emergent Themes	**Sub-Themes**
6. Mutual Awareness	**Awareness:** *Humanitarian Organizations:* Slightly less regulated except the bits that we are nervous about; before aim was to try to corral V&TC's do stuff we wanted; change now give us what you've got, we will make it clean; make suggestions about standards; understand V&TCs- no, I think UN and big mega NGO; STBF is a very good resources, not realize the capacity; humanitarian actors too busy; short discussion; very basic; excel files; awareness and this ability of outsourcing; maintaining a dialogue is too hard; clear scope and clear end goal; know what is missing and what people are doing; communicate very quickly and effectively; very difficult to communicate Bangladesh; Indonesia, they were extremely well organized; *V&TCs:* Basically voluntary OSM; background in communications, academics, logistics and media; people have an interest in disaster response**;** want to learn about the emergency management; different organizations complement each other and we have a relationship with each other; key performance indicators for evaluating success should be more clear; tensions that exist: huge amount of duplication of effort, have some organization; OSM collect from the community by the volunteers; used by

	the government or either humanitarian agencies; definitely one of the most trans parent ones; lacking capacity of understanding I need and how I read the information and the information quality; the V&TC get feedback; lack in accountability; recognize improvements are needed.
7. Cultivating Better Cohesion	**Cohesion:** *Communication* HOT is in communication with the government BNPB; BNPB is having cooperation with HOT to do mapping; SBTF 24hrs a day, six different time zones; use slack; enormous lot of data is now being lost to chat applications weaknesses- , meeting minutes and spreadsheets; challenging to maintain a disciplined approach to data management; moving so fast; WhatsApp group, we printed out about105 pages; *Teamwork* Hot frequently used; BNBP recognized the usefulness HOT; BNBP and HOT established for longtime; moving forward usually it is quite easily because both of us already know capabilities and how they work with each other; understand within Southeast Asia regions there is only one HOT OSM office which is in Indonesia; train data manager how usually things work, or what kind of sources of mechanism in terms of data varying, data quality, that sort of thing; know exactly what sort of language; know each other prior disasters that happened in the country, or during meetings, or a workshop; built on relationships and knowing somebody; emergency need to have the right person there who has this relationship; physically, know what is possible, and where the people in the field are looking for; attack the problem. They're not like zooming out; mutual understanding of objectives of systems of safeguards; much better place than we were; feedback.