

**The Impact of Crowdmapping on Humanitarian Response: A
Structurational Analysis**

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Declaration of Authorship

I, Abdul Rehman Shahid, hereby declare that this thesis and the work presented in it is entirely my own. Where I have consulted the work of others, this is always clearly stated.

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Acknowledgments

In the name of God, the Most Gracious, the Most Merciful

Besides feeling elated at reaching the end of my PhD, and excited about what the future holds, my feelings are somewhat poignant; this phase of my life has involved some really challenging moments, and has left me with many cherished memories. Fortunately, I had some great people around me who helped overcome the former and contributed to building the latter.

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Abstract

Crowdsourcing has proliferated due to the fertile ground created by advancements in digital infrastructures and social computing, which have facilitated access to the intellectual property of the masses. Despite this ever increasing proliferation, crowdsourcing remains largely underexplored in the current IS research literature, which adopts either the organisational or the crowd-action perspective; both perspectives essentially fail to provide an in-depth account of the change brought about by the phenomenon. This study explores in-depth crowdsourcing impact; in particular, those of crowdmapping initiatives. It answers the research question of whether the practices of crowdmapping impact humanitarian response and, if so, how and why. It aims to unravel the process through which crowdmapping becomes recognised and legitimised in humanitarian response. To this end, it adopts a qualitative, interpretive and process-based approach. Data collection involved semi-structured interviews, online data collection, and a review of documents and online resources. Concepts from structuration theory are adopted through which to interpret the collected data.

The analysis details how crowdmapping has gained recognition and legitimation in humanitarian response, and how dominant organisations have come to use it. It highlights how the role of the crowd has become increasingly important in humanitarian response, and how organisations have moved from a position of doubting the crowd, to requesting its involvement. The study shows that the crowd are a knowledgeable and reflexive collective. It doubts the dominating views that organisations can exercise full control over the crowd; rather, it shows the mutual control between the crowd and organisations. The findings also highlight the mutual dependency between crowdmapping and humanitarian response. Moreover, the findings shed light on the importance and diverseness of the intermediaries involved in the process of change—namely, events, networks, institutions, and technologies. The findings also highlight the complex role played by technology in the process of change, and the intrinsic motivations behind crowdmapping participation.

This study contributes to the IS crowdsourcing literature by taking a process-based interpretive approach that theoretically engages with the phenomenon to understand its impact. It concludes with its contributions to theory and practice, its limitations, and suggestions for further research.

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List of Abbreviations

AFCAT	United States Air Force Crisis Action Team
AIDR	Artificial Intelligence for Disaster Response
ANT	Actor-Network Theory
AST	Adaptive Structuration Theory
CIA	Central Intelligence Authority (United States Government)
COSMHA	Communauté OpenStreetMap Haiti
Crisis Mappers Network	The International Network of Crisis Mappers
DART	The Disaster Assistance Response Team (Canadian Armed Forces)
DHNetwork	The Digital Humanitarian Network
DHOs	Digital Humanitarian Organisations
DSWD	The Philippines Department of Social Welfare and Development
FEMA	Federal Emergency Management Agency (United States Department of Homeland Security)
HIU	Humanitarian Information Unit (United States Department of State)
HRI	Haiti Recovery Initiative
GIS	Geographic Information System
HOT	Humanitarian OpenStreetMap
ICCM	International Conference on Crisis Mapping
ICT	Information and Communication Technology
IS	Information Systems
ISS	Information Services Section
IT	Information Technology
NASA	The National Aeronautics and Space Administration (United States Government)
NDRRMC	The National Disaster Risk Reduction and Management Council (Philippines Government)
NEDA	The National Economic and Development Authority (Philippines Government)
NGA	National Geospatial-Intelligence Agency (United States Department of Defence)
NGO	Non-Governmental Organisation
NOAH	The Nationwide Operational Assessment of Hazards (Philippines Government)
OFDA	Office of United States Foreign Disaster Assistance
OIE	Office of Innovative Engagement (United States Department of State)
OSM	OpenStreetMap
OTI	United States Agency for International Development's Office of Transition Initiatives
PSIC	Punctuated Socio-Technical Information Systems Change Model
SBTF	The Standby Task Force
TAM	Technology Acceptance Model

UAV	Unmanned Aerial Vehicle
UN HCR	United Nations High Commissioner for Refugees
UN OCHA	United Nations Office for the Coordination of Humanitarian Affairs
USAID	United States Agency for International Development
V&TCs	The Volunteer and Technical Communities
VGI	Volunteer Geographic Information
WFP	United Nations World Food Programme

Chapter One: Introduction

1.1 Research Background and Motivation

Advancements in digital infrastructures, such as social computing, have given rise to an increasingly socio-technical world. Ever more, societies around the world are relying on technology in situations in which they never previously did (Oestreicher-Singer and Zalmanson, 2013; Yoo, 2010; Yoo et al., 2012). The phenomenon of crowdsourcing has proliferated due to the fertile environment created by advancements in digital infrastructures and social computing, which have made it easier to access the intellectual property of the masses. Crowdsourcing is the usage of the collective wisdom of a large group of people to solve certain problems and, in today's age, it has spread to many layers of society through the actions of individuals seeking the advantages of calling upon the crowd (Brabham, 2013; Howe, 2006b). Crowdsourcing is an inclusive phenomenon that promotes co-creation and interaction and expands the boundaries of distribution and collaboration. It can be defined as *“a type of participative online activity in which an individual, an institution, a non-profit organization, or company proposes to a group of individuals of varying knowledge, heterogeneity, and number, via a flexible open call, the voluntary undertaking of a task”* (Estellés-Arolas and González-Ladrón-de-Guevara, 2012, p. 197). A further definition which attempts to encapsulate the salient features of a wide variety of characterisations, defines crowdsourcing as *“a collaboration model enabled by people-centric web technologies to solve individual, organizational, and societal problems using a dynamically formed crowd of interested people who respond to an open call for participation”* (Pedersen et al., 2013, p. 580).

Crowdsourced tasks or initiatives can be of varying complexity and modularity, but the general idea of crowdsourcing involves a pool of contributors participating towards a collective goal with assets such as knowledge, experience, and money. In an ideal scenario, these collective contributions come together in a harmonious manner, fulfilling the requirements and objectives of the designated task or initiative. The crowdsourced relationship always entails a mutual benefit: the contributor achieves the satisfaction of a type of need, which can be economic or linked to self-esteem, skill development or social recognition; whilst the crowdsourcer gains the benefits that the contributor pool brings to

the particular task at hand (Brabham, 2013; Estellés-Arolas and González-Ladrón-de-Guevara, 2012; Howe, 2006b; Majchrzak and Malhotra, 2013).

Some researchers have gone as far as saying that the crowd should now be considered to be a fixed institution that is available on demand, whilst some major consulting firms have recognised the practical shift towards crowdsourcing and stated that the crowd should be viewed as a form of expanded workforce (Accenture, 2014; Boudreau and Lakhani, 2013; Deloitte, 2014). In essence, crowdsourcing initiatives operate on the concepts of 'diversity trumping ability' and of 'the wisdom of crowds', with research highlighting that, in certain challenges and tasks, large and diverse crowds of independent strangers are more effective than small groups of experts. Crowdsourcing initiatives can benefit from the diversification of ideas, as large numbers of contributors can give shape to novel ideas that, perhaps, small numbers of experts may not be capable of coming up with (Boudreau, 2012; Boudreau and Lakhani, 2013; Brabham, 2013; Surowiecki, 2004).

One of the motivations of this study is to add to the nascent Information Systems (IS) literature on crowdsourcing. IS research has lagged behind in the exploration of this phenomenon; there is a need for deeper research and exploration of the crowdsourcing phenomenon. Recently, efforts have been made by Zhao and Zhu (2014), Pedersen et al. (2013) and Tarrell et al. (2013) to provide more systematic contributions to the crowdsourcing literature, but a glaring lack of in-depth research remains; researchers have highlighted the 'great' research opportunities that the crowdsourcing phenomenon provides for the IS field.

The literature, in its present state, fails to provide an in-depth account of the impact that the phenomenon can deliver, and how it comes about. The current literature offers two different perspectives on crowdsourcing—namely, the organisational perspective, which views crowdsourcing more as a controlled phenomenon by presenting ways in which the crowd could be better organised or managed, and the second, the crowd-action perspective, which views crowdsourcing more as a phenomenon that can bring change in different contexts. It becomes apparent that the overall literature is inclined towards the organisational perspective, downplaying the role of the crowd and the impact that it can have. This contrast in the literature highlights an opportunity for research that considers both organisational and crowd-action aspects. Furthermore, it becomes apparent that process-based research within

the crowdsourcing literature is something of a rarity; therefore, the understanding of the process of crowdsourcing is limited. In addition, there is a lack of in-depth interpretive-based research, and the existing literature features minimal theoretical engagement. This highlights an opportunity for process-based interpretive research that theoretically engages with the phenomenon, considering both the structure and action elements (organisational and crowd-action perspectives); it is argued that such a study would result in a detailed portrayal of the change that the crowdsourcing phenomenon can deliver.

In summary, crowdsourcing is an important phenomenon, worthy of in-depth exploration, that can no longer be side-lined in the IS literature. The expansion of crowdsourcing capabilities may have important implications for solving the most crucial problems being faced by society; this represents one of the main motivations for studying the phenomenon of crowdsourcing (Boudreau and Lakhani, 2013; Brabham, 2008a; Majchrzak and Malhotra, 2013; Pedersen et al., 2013).

1.2 Research Context

The particular instance of crowdsourcing upon which this study focuses is crowdmapping. Crowdmapping is characterised by the collective and collaborative production of maps. The phenomenon is user-led, user-generated, and user-participatory, with a high contribution density. This user-led phenomenon brings together people under diverse values and in a remarkably quick manner. Moreover, this form of collective collaboration seems to disappear into thin-air after serving the purpose for which it came together. The crowdmapping technology upon which this study focuses is OpenStreetMap (OSM); the characteristics of OSM are sufficient for it to be considered a generative digital infrastructure. The community upon which this study focuses is the Humanitarian OpenStreetMap Team (HOT), which acts as a bridge or link between the OSM community and traditional humanitarian organisations and responders.

The study focuses upon the impact of crowdmapping on humanitarian response efforts; an area traditionally dominated by national and international organisations, and government agencies. The study paid particular attention to a large international humanitarian organisation, and how it moved from a position of trivialising crowdmapping to consistently using it as part of its humanitarian response efforts. The organisation is headquartered in

Washington D.C., the total 2014 revenue of which exceeded \$2.9 billion. This organisation strives to alleviate and prevent human suffering during emergencies by mobilising donor contributions and the power of volunteers to provide communities with the capabilities, in the form of shelter, care and hope, that ensures they are prepared and ready in case of disasters. It operates on the fundamental principles of humanity, unity, universality, independence, impartiality, neutrality and voluntary service. Historically, the organisation has responded to various disasters, both natural and man-made, including hurricanes, floods, tornadoes, earthquakes, fires, explosions, transportation accidents and hazardous material spills.

The study responds to two calls in the IS literature. First of all, within the IS literature, only minimal research exists that examines the use of IS outside of traditional commercial organisations. As technology is growing beyond the realm of the traditional commercial organisation and impacting and being used by the masses, it has become incumbent upon IS researchers to expand the intellectual boundaries of their work (Chiasson and Davidson, 2005; Yoo, 2010). Secondly, there has been a call within the IS literature for scholars to be concerned with how Information and Communication Technologies (ICTs) can help make the world a better place (Walsham, 2012). These ICTs provide the masses with the capabilities and opportunities to make a difference to their and other communities around the world. It has been argued that, if the IS field is to remain exciting, inspirational and attractive to future IS researchers, then it must embrace research into new technologies and in those contexts in which it has been shown that technologies play an important role in one form or the other. The world has changed radically since the early days of IS research and the field must reflect this change, lest it risk being side-lined as irrelevant. ICTs are now an inescapable reality for all organisations and countries of the world; their continuous proliferation has shown no sign of slowing down, with even the so called poor and illiterate embracing them in their millions. Technology has become increasingly present and ubiquitous in people's lives; thus, the IS field must take on and research interesting and creative contexts to expand its existing boundaries and reflect the truly technological savvy world in which we reside. Various IS researchers, including Galliers (2003), DeSanctis (2003), and Lyytinen and King (2004), have argued for the discipline to be more creative, boundless, expressive and plastic by venturing into new contexts and technologies.

1.3 Research Aims and Objectives

This research explores the impact of crowdmapping in the context of humanitarian response. It primarily focuses on two levels of analysis—namely, that at the community level (HOT community) and that at the organisational level (Humanitarian Organisation One). The study focuses on these two levels of analysis because of the nature of this industry (Chiasson and Davidson, 2005). Humanitarian response is an industry that is traditionally dominated by established national and international organisations, and government agencies. The effort of the crowd in this respect cannot be seen or explored in isolation of the organisations involved. In this regard, the study addresses the following research question:

- Do the practices of crowdmapping impact humanitarian response? And, if so, how and why?

Expanding on the research question, this study seeks to understand and explore in-depth the crowdmapping phenomenon that has proliferated, through advancements in digital infrastructures and social computing, in the context of humanitarian response. It explores the practices of contributors in the development of the crowdmap, a crowdsourced product, and the impact wielded by the developed crowdmap on a humanitarian organisation's response practices. Understanding these questions is important in order to elucidate the impact and change that crowdmapping is having on the *modus operandi* of a humanitarian organisation's response practices, as this is not made entirely clear from an examination of the existing literature.

In essence, crowdsourcing's increasing presence and ever expanding role and impact makes it a phenomenon that is crucial to explore and that can no longer be side-lined by the IS literature. The aims and objectives of this research are interesting, novel and creative, and the originality of its approach generates new insights and possibilities. The study empirically explores crowdmapping and provides an analytical account and characterisation of the phenomenon to enable the understanding of the impact that it is having in the context of humanitarian response.

1.4 Theoretical Foundation

To conceptualise and make sense of the collected data this research utilises Giddens's structuration theory as its theoretical foundation. The duality of structure proposed by

Giddens is the central aspect of structuration theory, in which structure and agency are viewed as being mutually constitutive and not independent of each other. Structuration theory views the social agent as being reflexive, knowledgeable, and always possessing the ability to act otherwise (Giddens, 1984). A major reason why this research adopts structuration theory is that it enables an adept understanding of change. Within the IS literature, many scholars, including Walsham and Han (1993), Karsten (1995), Sahay and Walsham (1997) and Barley (1986), have applied structuration theory to this effect. In essence, Giddens's structuration theory, with its balanced view of structure and action (structuration theory refers to action as 'agency'), is particularly relevant as this study explores whether the practices of crowdmapping impact humanitarian response and, if so, how and why.

Structuration theory is a theoretical foundation that places importance on the practices of social agents and on their impact. It is a theoretical lens that is suited to understand the objectives of the study through its apt recognition of human agency; i.e., that social agents possess the ability to transform social structures. Looking at how practices impact structure and then, in turn, at how they are impacted by it can be understood through the lens of structuration theory. This study argues that, although structuration theory is criticised for being too loose and containing concepts that are empirically weak or untested, it is still beneficial in unravelling the problematic nature of crowdsourcing and, in particular, crowdmapping.

1.5 Research Methodology

To explore its aims and objectives, this research adopts a qualitative interpretive approach. This approach was developed in social sciences to allow the in-depth exploration of social and cultural phenomena (Myers, 2012). Interpretive research is based upon the assumption that given or socially constructed reality can only be accessed through constructions such as shared meanings, language and consciousness. Interpretive research is philosophically based upon phenomenology and hermeneutics and attempts to understand phenomena through the eyes of the researcher by way of assigned meanings (Walsham, 1995). The data were collected over a significant temporal period—namely, from 2009 to 2015. The chosen temporal boundary highlights the process-based nature of this study, which enabled a better

understanding of the impact of crowdmapping. Importantly, the collected data detail a number of key events that contributed towards change.

Specifically, the data collection consisted of voice and video interviews, online data, and of document, newspaper and media reviews. 43 voice and video interviews were conducted in addition to email communication with nine other participants. Online data were collected, from a mailing list/forum and through instant messaging. Documents and online resources were reviewed, including agency reports, news items, television interviews and video recordings. The 43 voice interviews were conducted with various actors, including the HOT community, and various humanitarian organisations, including the American Red Cross, United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA), MapAction, and specialists from the Philippines Government – the National Economic and Development Authority (NEDA). Further interviews were conducted with relevant actors from DigitalGlobe and Mapbox. Among the advantages of conducting semi-structured interviews was that it enables the researcher to gain insights into how participants view the world through the method's inherent flexibility (Bryman, 2012; D. Silverman, 2010).

1.6 Outline of Thesis

The following is the outline of my thesis:

- Chapter one – Introduction. The introduction chapter sets the scene for the exploration of the phenomenon of crowdsourcing and, in particular, crowdmapping. It presents the research background and motivation of the study, and the research context. It then presents its aims and objectives, and how these are tackled by the adopted theoretical foundation and research methodology. The chapter lays the foundation for the in-depth exploration of whether the practices of crowdmapping impact humanitarian response and, if so, how and why.
- Chapter two – Literature Review. This chapter conducts a critical review of the crowdsourcing literature. It begins by arguing how advancements in digital infrastructures and social computing have resulted in the proliferation of crowdsourcing. It then presents two different perspectives that the literature review made evident—namely, the organisational and crowd-action perspectives. It then provides an assessment of the

current literature, in which it is argued that, in its present state, the literature fails to provide an in-depth account of the change that the phenomenon can deliver; this is because the existing literature leans towards the organisational perspective, downplaying the role of the crowd and its potential impact. The review presents an opportunity for this study to take on a particular form—namely, a process-based interpretive approach that theoretically engages with the crowdsourcing phenomenon, considering both structure and action elements (organisational and crowd-action perspectives).

- Chapter three – Theoretical Foundation. This chapter reviews a number of theoretical perspectives that deal with change, and specifically, social and technological change—namely, Structuration Theory, Theory of Practice, Actor Network Theory (ANT), the Technology Acceptance Model (TAM), and the Punctuated Socio-Technical Information Systems Change (PSIC) Model. The chapter focuses considerably more on structuration theory, as this was the theoretical foundation adopted, based on the research logic of this study. The main concepts utilised from structuration theory are explained in detail—namely, the concept of the duality of structure, which includes Giddens’s ideas of agency, structure and of the modalities of structuration (Giddens, 1984). Also, the chapter discusses the various ways in which the IS discipline has made use of structuration theory, and argues that there is a need to go back to the theory’s original notions. Moreover, it argues that the IS structural literature needs to examine additional contexts and types of IS.
- Chapter four – Research Methodology. This chapter goes into detail in regard to the research methodology, beginning with the researcher’s philosophical assumptions in undertaking the research, which is an interpretive stance. It then details the methods undertaken—namely, a case study with semi-structured interviews—and how these prove insightful in exploring the research’s aims and objectives. Furthermore, detail is provided on data collection and analysis. Importantly, to answer the research questions, data were collected over a significant temporal period—namely, from 2009 to 2015. The chosen temporal boundary highlights the process-based nature of this study, which enables a better understanding of the impact of crowdmapping, as compared with, for example, cross-sectional data. Specifically, the data collection consisted of voice and video

interviews, online data, and of document, newspaper and media reviews. This diversified collection strategy enabled the in-depth exploration of both technical and non-technical literature. In total, 43 voice and video interviews were conducted in addition to email communication with nine other participants. Online data were collected, from a mailing list/forum and through instant messaging, and the documents and online resources reviewed included agency reports, news items, television interviews, and video recordings. The 43 voice interviews were conducted with various actors, including the HOT community, and various humanitarian organisations, including the American Red Cross, UN OCHA, MapAction, and specialists from NEDA. Further interviews were conducted with relevant actors from DigitalGlobe and Mapbox to ensure a comprehensive understanding and exploration of crowdmapping in the context of humanitarian response.

- Chapter five – Case Study. This chapter presents a case study of the development of crowdmapping in the context of humanitarian response. It traces the development of crowdmapping between 2009 and 2015 and describes the various developments and changes that have taken place over this period of time. It is useful to begin with the 2010 Haitian earthquake as the first major response, as this represents the disaster which saw the rise of crowdsourcing and, in particular, crowdmapping to increasing prominence. The major crowdmapping developments explored include, in chronological order, the Haiti response, the rise of digital humanitarian organisations, the 2011 Libya and Japan responses, technological advances related to crowdmapping, the Typhoon Haiyan response, and the development of the partnerships and agreements between actors since Haiti.
- Chapter six – Analysis. This chapter applies concepts taken from structuration theory to understand the impact of crowdmapping on the chosen humanitarian organisation's response efforts. The modalities of structuration model, as proposed by Giddens (1984), reveals changes in meaning, domination and legitimation; evolving meaning and the emergence of legitimation within Humanitarian Organisation One in regard to crowdmapping for humanitarian response, and the challenging of domination by the HOT community in regard to the imagery procurement process. Furthermore, the analysis

shows that the impact of crowdmapping is not a straightforward cause and effect one. It reveals that OSM crowdmapping practices have both impacted and have been impacted by Humanitarian Organisation One in a mutual relationship. Also, the chapter details the critical issues facing the HOT community in regard to four main areas; it is important to stipulate these because of the mutual relationship. Additionally, the chapter sheds light on the explored crowdmapping community.

- Chapter seven – Discussion. This chapter presents a discussion of the study's main findings. In relation to these, the discussion points explored are the role of the crowd, the increasing role of crowdmapping in humanitarian response, the mutual dependency between crowdmapping and humanitarian response, the diverseness of intermediaries in the process of change, the complex role played by technology, and the intrinsic motivations behind crowdmapping participation. In highlighting the active role played by the crowd in humanitarian response, this study argues that control over the crowd remained somewhat difficult despite the measures that the HOT and Humanitarian Organisation One hierarchies attempted to implement. Rather than a controllable entity, the crowd should be viewed as being knowledgeable, reflexive, and always possessing a dialectic of control. The increasing role of crowdmapping in humanitarian response, highlights the digital humanitarian as an actor who crowdmaps during a disaster situation because of the technology at their disposal, and on the most part, undertakes no other humanitarian related work during a disaster situation. The mutual dependency between crowdmapping and humanitarian response is examined in light of the identified duality between the practices of the OSM contributors and those of Humanitarian Organisation One. Specifically, the duality is indicated by Humanitarian Organisation One investing into OSM both creatively and financially, through the redevelopment of the tasking manager. The diverseness of intermediaries in the process of change highlights the important role played by intermediaries in the process of change. For the crowdmapping initiative explored by this study, the intermediaries included the holding of conferences, the formation of networks, the establishment of institutions, crowdmapping exercises, humanitarian responses, negotiations (involving an online petition), the testing of new imagery sources, and various other technological aspects, including quality control and humanitarian technological developments. The study also highlights the complex role

played by technology; in acting as an intermediary and depending on user perspective, it can be seen as playing both controlling and enabling roles at the same time. Finally, the study highlights the dominance of intrinsic motivations behind crowdmapping participation. The motivations of contributors were found to be previous mapping history, an interest in maps, helping others and making a difference, a hobby, friendly competition, promoting open-source and free-data, and going beyond monetary assistance.

- Chapter eight – Conclusion. Chapter eight presents the conclusion chapter. This chapter begins with the research summary, which recaps all the chapters of the thesis. The chapter then moves onto the research contribution of this study to the IS crowdsourcing literature and to the wider discipline, to IS structural literature, and to practice. From the contribution to structuration theory standpoint, the novel way in which the theory is applied is articulated—namely, in terms of the types of organisations and technologies explored. From the contribution to practice standpoint, ways in which the identified critical issues facing the HOT community could be tackled are explored. The chapter concludes with the limitations of the study, and suggestions for further research.

Chapter Two: Literature Review

This chapter, subdivided into six sections, presents an in-depth account of the crowdsourcing literature. Section one presents the definitions of crowdsourcing and crowdmapping, the crowdsourcing instance focused upon by this study. Section two focuses upon the emergence of crowdsourcing and on how it has grown exponentially and increasingly proliferated through advancements in digital infrastructures and social computing. Section three presents the conceptualisation of the crowd found in the literature, whilst section four presents the literature on the process of crowdsourcing. Section five presents the assessment of the literature. The sixth and final section presents the summary of the chapter.

2.1 Crowdsourcing

The literature remains somewhat ambiguous in providing a widely accepted definition of crowdsourcing. This can, in part, be attributed to research focusing on specific aspects of a crowdsourcing system within a particular setting, demonstrating the difficulties encountered in developing a common definition that can cover all applications and settings (Zhao and Zhu, 2014).

Howe (2006b), who has been credited with developing the concept, defined it as *“the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in an open call”* (Howe, 2006b). Estellés-Arolas and González-Ladrón-de-Guevara (2012) developed a more integrated definition and described it as an inclusive phenomenon that promotes co-creation and interaction, and expands the boundaries of distribution and collaboration. It is defined as *“a type of participative online activity in which an individual, an institution, a non-profit organization, or company proposes to a group of individuals of varying knowledge, heterogeneity, and number, via a flexible open call, the voluntary undertaking of a task”* (Estellés-Arolas and González-Ladrón-de-Guevara, 2012, p. 197). In an attempt to encapsulate the salient features of crowdsourcing, Pedersen et al. (2013) defined it as *“a collaboration model enabled by people-centric web technologies to solve individual, organizational, and societal problems using a dynamically formed crowd of interested people who respond to an open call for participation”* (Pedersen et al., 2013, p. 580).

In order to reduce the ambiguity surrounding the phenomenon, Zhao and Zhu (2014) distinguished crowdsourcing from other phenomena, including outsourcing, open-innovation and open-source. Outsourcing, which occurs when an organisation contracts an external agent or agents to perform one or more organisational activities, has been viewed by some as being a web 2.0 form of crowdsourcing. Despite the two overlapping in some ways, there are differences between them—namely, in the use of the word ‘contract’ within outsourcing. In outsourcing initiatives, inputs and outputs are based on contractual agreements; conversely, in crowdsourcing problems or initiatives, the issuers give out an open call for input or assistance, which is then answered in a voluntaristic basis by mass contributors. Furthermore, drawing up contracts pertaining to crowdsourcing initiatives would be far more difficult, simply because of the vast number of contributors and, on occasion, of their desire to remain anonymous. To add to this difficulty, whereas outsourcing initiatives usually entail financial incentives, crowdsourcing contributors are driven by many different motivations, either extrinsic or intrinsic, which include financial gain, altruism, the need to feel useful, fun, and the desire to learn (Arakji and Lang, 2007; Doan et al., 2011; Geiger et al., 2011; Leimeister et al., 2009; Müller et al., 2010).

In terms of open-innovation, which is an organisation’s inclusion of users into the innovation process and an approach for value creation, some authors, including Leimeister et al. (2009) have argued that open-innovation can be undertaken through crowdsourcing initiatives. Although open-innovation and crowdsourcing share the concepts that crowd-wisdom can be leveraged and crowd-intelligence capitalised upon, they are not the same. Firstly, whereas open-innovation merely targets innovation processes, crowdsourcing involves a much broader exposure and user capitalisation. Another difference is found in the communication aspect; open-innovation tends to interact with all actors, including other organisations and clients, whereas crowdsourcing centres upon technology mediated mass collaboration, communication and participation.

The open-source concept, which can be seen as an overarching product development philosophy that involves giving users access to the essential components of a software or system for the purpose of improvement through collaboration, also differs from crowdsourcing. Despite Howe (2008) stating that crowdsourcing is an application based on open-source principles, Zhao and Zhu (2014) argued against this. In essence, crowdsourcing

is not open in the same way in which open-source is; this is demonstrated by the fact that, in crowdsourcing contexts, the investing organisation that reaches out to the crowd holds the intellectual property rights for the initiative, which is not the case in open-source ones. Furthermore, in crowdsourcing, contributors are driven by an array of reward-based motivations, which, as mentioned above, can include financial gain, altruism, the feeling of usefulness, fun, and the joy of learning. In comparison, the reward dispensed in an open-source context is limited to the actual development that is gained by the software or system. Finally, differences also exist between the manners in which the work is done; whereas contributions to crowdsourcing initiatives can be made either independently or collaboratively, open-source initiatives usually involve working together, with intricately linked contributions, and require a high level of coordination among the actors.

Crowdsourcing can be used to tap co-creation or crowd-creation (the community produces a creative work together), crowd-wisdom (the community provides a collective opinion), crowdfunding (the community jointly funds a project), and crowdvoting (the community organises and ranks various content) (Pedersen et al., 2013). A further use of crowdsourcing involves micro-tasking, which can also fall under co-creation, in which the community performs small tasks that are part of a larger project (Afuah and Tucci, 2012; Pelzer, 2013).

2.1.1 Crowdmapping

Crowdmapping has been defined in many different ways; this study adopts the following definition: *“the aggregation of crowd-generated inputs such as text messages and social media feeds with geographic data to provide real-time, interactive information on events such as wars, humanitarian crises, crime, elections, or natural disasters (the results are sometimes referred to as crisis maps)”* (Quaintance, 2014). Essentially, it is an example of co-creation, micro-tasking, crowd-creation and, to some extent, crowd-wisdom.

Crowdmapping is an inherently interdisciplinary subject, covering many diverse fields. This was highlighted by Ziemke (2012), who stated that crowdmapping is *“situated at the nexus of many fields, drawing from debates in disciplines as diverse as: geography, epidemiology, sociology, environmental science, political science, forestry, ecology, psychology, linguistics, robotics, communication, cultural studies, statistics, mathematics, conflict studies, art and design, computer science and disaster and emergency management”* (Ziemke, 2012, p. 102)

2.2 The Emergence of Crowdsourcing

Crowdsourcing has existed throughout history, but has recently flourished due to advancements in digital infrastructures and social computing. Organisations of different sizes and with different objectives are increasingly turning to the collective wisdom of the crowd to capitalise on external expertise for the solution of a wide variety of problems. In practice, crowdsourcing initiatives have shown exponential growth, with one popular platform (www.crowdsourcing.org), reporting a 100% increase in the number of entities offering crowdsourcing services over a time frame of just two years (Tarrell et al., 2013). Despite this ever increasing proliferation, crowdsourcing remains largely underexplored in IS research; Zhao and Zhu (2014) argued that crowdsourcing *“has seen its wide applications in practice and is yet to receive intense attention from the scholars”* (Zhao and Zhu, 2014, p. 417). Positively, Afuah and Tucci (2012) stated that *“the fascinating phenomenon of crowdsourcing promises to be a rich source of theoretical and empirical knowledge and scholarly activity for many years to come”* (Afuah and Tucci, 2012, p. 372).

Figure 1 demonstrates how advancements in digital infrastructures and the rise in social computing have contributed towards this proliferation, and how this has led to the formation of digital communities:

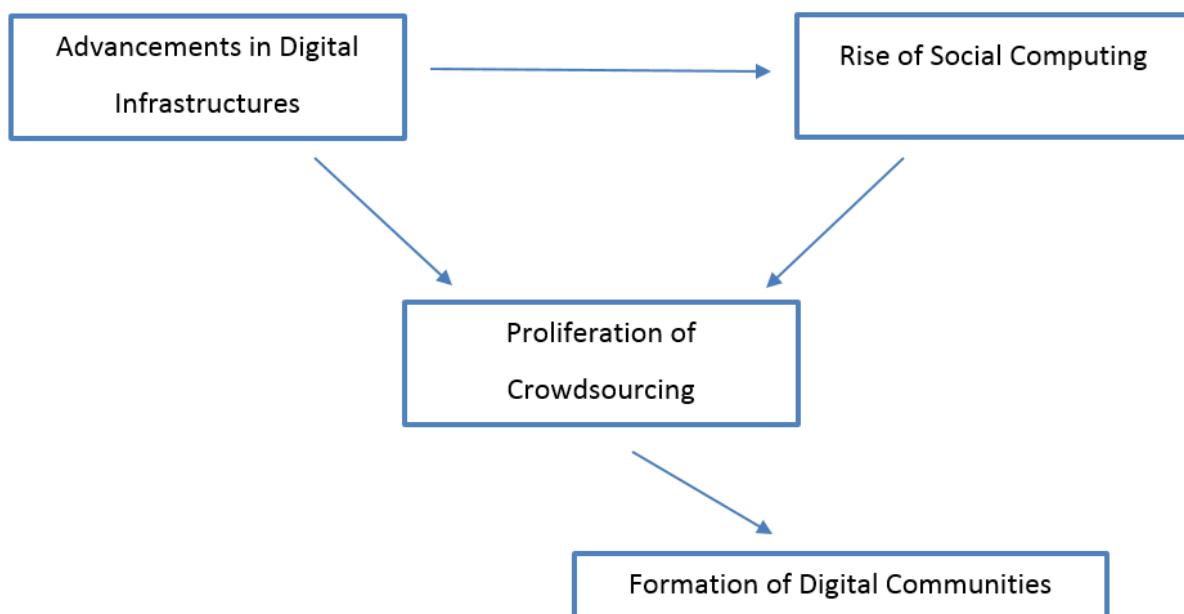


Figure 1 - The proliferation of crowdsourcing

2.2.1 Digital Infrastructures

Digital infrastructures are the result of the increased technological capabilities that have made it possible to develop ever more versatile and complex IS. It has been argued that the 21st century is the century of digital infrastructures (J. Braa et al., 2007; Bygstad, 2010; Elaluf-Calderwood et al., 2011). Digital infrastructures are defined as *“basic information technologies and organisational structures, along with the related services and facilities necessary for an enterprise or industry to function”* (Tilson et al., 2010, p. 1). A digital infrastructure is also defined as a *“shared, open (and unbounded), heterogeneous and evolving, socio-technical system (which we call installed base) consisting of a set of IT capabilities and their user, operations and design communities”* (Hanseth and Lyytinen, 2010, p. 4).

Looking at the characteristics of a digital infrastructure, some important aspects of its definition are that it is a type of Information Technology (IT) artefact that is open, shared, heterogeneous and evolving. In a more recent and comprehensive definition, digital infrastructures have been characterised by *“openness to number and types of users (no fixed notion of ‘user’), interconnections of numerous modules/systems (i.e. multiplicity of purposes, agendas, strategies), dynamically evolving portfolios of (an ecosystem of) systems and shaped by an installed base of existing systems and practices (thus restricting the scope of design, as traditionally conceived)... also typically stretched across space and time: they are shaped and used across many different locales and endure over long periods (decades rather than years)”* (Monteiro et al., 2013, p. 576).

Digital infrastructures are made up of a collection of technological and human components, systems, networks and processes that aggregate and function as complex IS. These infrastructures are characterised by their dynamism, longevity, recursivity, scalability, and upward and downward flexibility. Digital infrastructures are never fully complete and, depending on their type, the general public is trusted to invent and share good ideas that could add to them. Recently, infrastructure definitions have begun to move away from characterising them as ‘objects’, towards more process orientated ones that focus upon their usage, design, implementation and further development. Examples of digital infrastructures include the internet, health and corporate systems, and social networking sites such as LinkedIn and Facebook (Bygstad, 2008; Hanseth and Lyytinen, 2010; Henfridsson and Bygstad,

2013; Monteiro et al., 2014; Tilson et al., 2010). Importantly, digital infrastructures enable generativity, which is the ability of any self-contained system to produce, generate or create new outputs, behaviours or structures, *without* the input of its originator. It is the technologies' capacity *"to produce unprompted change driven by large, varied, and uncoordinated audiences"* (Zittrain, 2006, p. 1980).

2.2.2 Social Computing

It has been argued that developments in digital infrastructures have given rise to the widespread adoption of social computing (Oestreicher-Singer and Zalmanson, 2013). The rise of social computing is demonstrated by the fact that IT has become commonplace not only in our workplaces, but also in our homes and personal lives, becoming an unavoidable part of our daily activities and routines (Yoo, 2010). Social computing can be defined as *"intra-group social and business actions practiced through group consensus, group cooperation, and group authority, where such actions are made possible through the mediation of information technologies, and where group interaction causes members to conform and influences others to join the group"* (Vannoy and Palvia, 2010, p. 149).

Due to its nascent nature, social computing has no set definition; further definitions have included ideas such as online communities, user-distributed content, and social networks, or even concepts such as cheap devices, shared computing resources and easy connections (Vannoy and Palvia, 2010). Social computing is a prime example of how widespread technological diffusion is and of how deeply technology has become embedded in our lives. It has been argued that this has happened to the extent that *"it is nearly impossible to disentangle business and social processes from their underlying IT infrastructures"* (Oestreicher-Singer and Zalmanson, 2013, p. 593). Furthermore, these authors stated that *"during the last two decades, the digital infrastructure of business and society has shifted radically, and researchers and managers alike have acknowledged that the role of IT has undergone a transformation. IT has become immersed in the workspace and in homes, developing into an unavoidable part of both daily routines and business processes"* (Oestreicher-Singer and Zalmanson, 2013, p. 593).

The widespread diffusion of social computing has led to the development of social media tools such as Facebook and MySpace, and crowdmapping tools such as OSM. The technological

capabilities that have been placed in the hands of common individuals not only allow them to develop technological initiatives, but to also use them in far reaching ways that cross previously existing social and technological boundaries. In essence, social computing has given rise to IS capabilities that have transferred power from organisations to individuals; the low levels of technological expertise it requires enable the latter to manifest creativity, contribute expertise, share content, engage in deep interaction and disseminate information. Furthermore, social computing has given rise to new forms of co-creation and interaction, with many authors arguing for its transformational force (Li and Joshi, 2012; Oestreicher-Singer and Zalmanson, 2013; Parameswaran and Whinston, 2007; Vannoy and Palvia, 2010).

2.2.3 The Rise of Crowdsourcing

The transformational force of social computing—and, specifically, progression in web 2.0 technologies—has led to the proliferation of crowdsourcing (Tilson et al., 2010; Zhao and Zhu, 2014). The recent upsurge of crowdsourcing initiatives, either crowdfunding or crowdmapping ones, has not risen out of thin air; it is the result of advancements in digital infrastructures and social computing. This study argues that it is not possible to fully grasp the increasing proliferation of crowdsourcing unless the developments in digital infrastructures and social computing are understood. By breaking down the definition of digital infrastructures, it becomes apparent that these are IS that are shared, open, unbounded, heterogeneous, open to users, dynamically evolving, and stretched across space and time; all these characteristics are the hallmarks of a foundation that enables crowdsourcing to flourish. Taking their openness and unboundedness into consideration, digital infrastructures, both in theory and practice, are fertile environments for the success of a phenomenon like crowdsourcing. Crowdsourcing's success is not only down to the development of digital infrastructures, but also to the increase in social computing. Whereas digital infrastructures provide the technological capabilities, the evolution of social computing heralds a change in societal and individual behaviours towards a more technology-centric model; this is especially the case with digital natives. Social computing operates on the notion that technology has become so deeply embedded in our lives that the lines between the social and the technical spheres are becoming increasingly blurred; it is this deep embedment of technology that has contributed to the proliferation of crowdsourcing. Additionally, through cooperation and authority, social computing promotes intra-group actions that are mediated

through ICTs. The deep embedment of social computing in society has provided a fertile ground on which crowdsourcing can thrive.

Furthermore, the online communities that are fostered through crowdsourcing initiatives represent a new type of organisation that differs from the ideals of traditional ones (Jarvenpaa and Lang, 2011). In online communities, ideas, resources and members rapidly flow in and out, and boundaries are highly dynamic and permeable. This understanding of boundaries is in contrast to that found in traditional organisations, in which they are considered to be relatively stable. This permeability and dynamism of online communities places more importance on the role of boundary management, which refers to *“a set of activities involved in defining, negotiating and protecting organisational resources and domains of action, as well as managing relationships with external stakeholders, to achieve organisational goals”* (Jarvenpaa and Lang, 2011, p. 441).

Boundary management seeks to balance tensions and seek trade-offs between the paradoxes of change and control that can exist in digital infrastructures. The paradox of change is defined by the opposing logics of flexibility and stability which operate across infrastructural layers. This is where digital infrastructures have to be stable enough to allow the acceptance of new actors, processes etc., whilst affording the flexibility necessary for boundless growth. The paradox of control relates to the strategic initiatives of heterogeneous actors in relation to generativity and control at various points of the digital infrastructure. Conflicts can be caused by the convergence of information, which can put pressure on the infrastructure. Also, certain actors may engage in active interference, which increases complexity and can cause a breakdown in infrastructural operations (Bygstad, 2010; Elaluf-Calderwood et al., 2011; Faraj et al., 2011; Tilson et al., 2010).

2.3 Crowdsourcing Perspectives

2.3.1 Selection, Identification and Classification

When conducting its review of crowdsourcing, this study had to adopt a flexible approach to its search for literature. Initially, the author scanned the ‘basket of 8’ IS journals for relevant studies; this search also included papers that did not explicitly mention the term ‘crowdsourcing’, but described the phenomenon by some other word. The small number of papers found by the author through this initial process highlighted the nascent nature of the

IS crowdsourcing literature. It was thus decided to expand the search beyond the confines of the IS literature, and that it should furthermore include conference papers. For different purposes, various scholars have argued in favour of going beyond the confines of IS literature. For example, Webster and Watson (2002) opined that, when writing a literature review, IS scholars must often look to other fields beyond their own; Wastell and White (2010) contended that, when publishing, IS scholars should consider a range of outlets in different fields, and not just in their own. Once this new criterion had been implemented, the search was far more fruitful. After going through the described search process, 47 papers were reviewed in total, presenting, as a result, the current state of the crowdsourcing literature.

The author initially classified the literature according to themes, with the three dominant ones being quality control, motivation and outcomes. Of the 47 papers reviewed, 18 were on quality control, 11 on motivation and 24 on outcomes (this adds up to more than 47 because some of the papers explored more than one theme e.g. Leimeister et al. (2009), was classified for both the motivation and outcomes themes. Once the themes had been identified and a number of prominent studies under each theme had been collected, the author moved on to a conceptual classification of the literature. It became apparent that the three areas represent two different crowdsourcing perspectives. These are the *organisational perspective*, which views crowdsourcing more as a controlled phenomenon by presenting ways in which the crowd could be better organised or managed, and the *crowd-action perspective*, which views crowdsourcing more as a phenomenon that can bring change in different contexts. The quality control and motivation literature inclines towards the organisational perspective, whilst the outcomes literature inclines towards the crowd-action perspective. Furthermore, it became apparent that the perspective was largely dependent on the type of research (see appendix 1); with the organisational perspective literature largely linked to functionalist-based research, and the crowd-action perspective literature largely linked to descriptive-based research. Both perspectives are explored in turn.

2.3.2 Organisational Perspective

From the crowdsourcing literature, it becomes apparent that considerable focus is placed upon the ways in which the crowd could be better organised or managed; this is primarily made evident by functionalist-based research. The three main research areas that subscribe

to this functionalist approach are controlling output quality, managing motivation and assessing outcomes. The following sub-sections discuss these research areas.

2.3.2.1 Controlling Output Quality

Quality control is a research area that dominates the crowdsourcing literature and focuses on two main aspects. Firstly, it details the different methods that can be adopted by crowdsourcing systems to control output quality. Secondly, it details the importance of quality control and its effective management in crowdsourcing systems (*see table 1*). From the conducted review, the prevalence of functionalist-based research becomes apparent. Table 1 shows that, out of the 18 papers reviewed on quality control, 16 were based on a functionalist approach, one each based on descriptive- and variance-based approaches, and no process- or interpretive-based studies. Typically, functionalist-based research on quality control proposes various quality control methods (occasionally through a model, framework or architecture), that could benefit crowdsourcing systems, from the outset, to effectively manage the crowd and improve their output.

Table 1 - Quality control crowdsourcing literature

<u>Focus of Research Area</u>	<u>Type of Research (Descriptive/Functionalist/Variance/Process/Interpretive – see appendix 1)</u>	<u>Context (Commercial/Non-Commercial use of Crowdsourcing Systems)</u>
<p><u>Different ways of controlling quality in crowdsourcing systems is identified:</u></p> <ul style="list-style-type: none"> - <u>Rating mechanisms:</u> (Riedl et al., 2010) - <u>The map-reduce approach</u> (Kittur et al., 2011) - <u>The evolutionary approach</u> (Yung et al., 2014) - <u>Slow intelligence</u> (Yung et al., 2014) - <u>Arbitration</u> (Hansen et al., 2013) - <u>Peer-review</u> (Hansen et al., 2013) - <u>Double peer-review</u> (Hansen et al., 2013) - <u>Algorithmic and machine learning/text mining</u> (Hansen et al., 2013) - <u>Training (sample tasks, gold-standard data, validation procedures and feedback)</u> (Hiltunen, 2011; Le et al., 2010; J. Y. Moon and Sproull, 2008; Poesio et al., 2013) <p><u>Importance of quality control and managing quality control:</u> (Allahbakhsh et al., 2013; Barron et al., 2014; Erskine and Gregg, 2012; Gao, Barbier, et al., 2011; Gao, Wang, et al., 2011; Girres and Touya, 2010; Goodchild and Glennon, 2010; Malhotra and Majchrzak, 2014; Over et al., 2010; Pedersen et al., 2013)</p>	<p><u>Descriptive:</u> (Pedersen et al., 2013)</p> <p><u>Functionalist:</u> (Allahbakhsh et al., 2013; Barron et al., 2014; Erskine and Gregg, 2012; Gao, Barbier, et al., 2011; Gao, Wang, et al., 2011; Girres and Touya, 2010; Goodchild and Glennon, 2010; Hansen et al., 2013; Hiltunen, 2011; Kittur et al., 2011; Le et al., 2010; Malhotra and Majchrzak, 2014; J. Y. Moon and Sproull, 2008; Over et al., 2010; Poesio et al., 2013; Yung et al., 2014)</p> <p><u>Variance:</u> (Riedl et al., 2010)</p> <p><u>Process:</u> -----</p> <p><u>Interpretive:</u> -----</p>	<p><u>Commercial:</u></p> <ul style="list-style-type: none"> - <u>Commercial use of crowdsourcing systems.</u> Systems include Amazon Mechanical Turk, TrendWiki, Innovation based systems, <u>Phrase Detectives:</u> (Allahbakhsh et al., 2013; Hiltunen, 2011; Kittur et al., 2011; Le et al., 2010; Malhotra and Majchrzak, 2014; J. Y. Moon and Sproull, 2008; Pedersen et al., 2013; Poesio et al., 2013; Riedl et al., 2010) <p><u>Non-Commercial:</u></p> <ul style="list-style-type: none"> - <u>Non-commercial use of crowdsourcing systems.</u> Systems include OSM, FamilySearch Indexing, Tourism based systems, <u>Humanitarian based systems:</u> (Barron et al., 2014; Erskine and Gregg, 2012; Gao, Barbier, et al., 2011; Gao, Wang, et al., 2011; Girres and Touya, 2010; Goodchild and Glennon, 2010; Hansen et al., 2013; Over et al., 2010; Yung et al., 2014)

Kittur et al. (2011) developed the ‘CrowdForge’ framework. The authors highlighted the increasing role played by micro-tasking, in which organisations utilise a large number of workers for different purposes. Micro-task markets usually involve the distribution of simple tasks, but organisations are increasingly looking at ways in which more complex and

interdependent tasks can be distributed. The authors utilised various complex tasks to test the presented 'CrowdForge' framework, which can be used to distribute interdependent and complex tasks through micro-tasking; tasks include decision making, article writing and science journalism. Importantly, the study articulates the importance of quality control to avoid a bad contribution adversely impacting the task as a whole, when a complex task is broken down into a number of individual contributions. The authors proposed quality control methods that utilise human intelligence—namely, the map-reduce approach. This approach makes additional use of map or reduce tasks for quality control; map tasks are those in which a specified task is undertaken by one or more contributors, whilst reduce tasks are those in which the results of multiple contributors are amalgamated into one single output. Quality control methods include the verification by contributors of the contributions made by others (represented through map tasks) and the selection of a single best contribution from an array (represented through reduce tasks) by means of a voting process. Other methods include the combination by contributors of the best parts of a number of the same task contributions, in lieu of the selection of a single contribution (represented through reduce tasks). The latter method has the particular advantage of not adding complexity, as quality control tasks are no more complex than contribution ones. The authors found the quality control method of combining a number of the same task contributions to be more effective than the voting method. Although it is a valuable contribution, the CrowdForge framework has several limitations. These include the lack of support for iteration, meaning that the task designer has to specify each stage in the task flow. Furthermore, it may be the case that it may not be possible to break down some tasks finely enough to match the workforce's task capacity, which would disrupt CrowdForge's fundamental assumption that complex work can be broken down into small and independent parts, with the system managing the coordination between each.

Yung et al. (2014) built on the work done by Kittur et al. (2011) through proposing a crowdsourcing system architecture that would enable a new quality control approach utilising evolutionary computing and slow intelligence. The authors argued that the developed evolutionary approach is more effective at quality control than, for example, the voting method proposed by Kittur et al. (2011). This is because the voting method merely selects the contribution of the highest quality from those that have already been made, whereas the

evolutionary approach aims to incrementally enhance answer quality utilising slow intelligence. By presenting two case studies and testing the proposed architecture through a tourism based system, Yung et al. (2014) found that their approach improves answer quality. The limitations of the evolutionary approach include its unsuitability for tasks that are simple or have exact answers, and for any initiative in which there is a small number of contributors as, to be effective, the evolutionary computing aspect relies on ‘many generations’ of contributions.

Hansen et al. (2013) explored the FamilySearch crowdsourcing initiative, in which contributors transcribe/index ancestral records, building up a comprehensive collection of genealogical records. The authors explored the effectiveness (accuracy) and efficiency (time) of two quality control mechanisms put in place by the crowdsourcing system—namely, arbitration and peer review. Arbitration takes place when the independent transcriptions of two or more contributors are conflicting, and peer review takes place when contributions are reviewed by other contributors. The peer review method is similar to that referred to by Kittur et al. (2011), in which contributors verify the contributions made by others; the method is also backed by other scholars, including Blohm et al. (2013), who stated that the crowd itself should be involved in improving data quality. Hansen et al. (2013) found that the peer review method is significantly more efficient than the arbitration one in terms of time, but not as effective, in terms of accuracy, in certain fields. Interestingly, the authors found that the arbitration of peer reviewed contributions does not necessarily increase quality. Notably, it was realised that the more experienced the contributors were, the higher was the quality of the contributions. Furthermore, the time in which each task was completed was much shorter when a more experienced contributor actioned it. The authors emphasised the importance of retaining the more experienced contributors and continually motivating those that are less so. Importantly, the authors also proposed additional quality control methods that could be implemented by the crowdsourcing system. These include a double peer review method, in which a peer reviewed contribution is passed on to another reviewer; algorithmic and machine learning/text mining procedures; and a correction system similar to that of Wikipedia, by which corrections can be made at any time. This would bring into existence somewhat ‘living documents’ that can constantly be updated.

Allahbakhsh et al. (2013) classified quality control methods into two categories: design-time and real-time.

Design-time quality control methods address effective task preparation and contributor selection. Effective task preparation entails the adoption of a defensive design that provides a clear-cut task description that defines the compensation policy. Furthermore, each task should be designed in such a way that makes it easier to contribute than to cheat. Contributor selection entails making an open-call that allows anybody to contribute to the task. This having been said, task contribution should be reputation- and credential-based; this means that certain tasks will only be actionable by those contributors that have a required degree of reputation and credentials.

Real-time quality control methods address expert review, ground truth, input agreement, output agreement, majority consensus, contributor evaluation, and real-time support. Expert review involves experts of the crowdsourcing system checking the quality of the contributions. Ground truth refers to comparing contributions with a 'gold standard'; e.g., what is known, as a fact, to be the best possible correct output of the contribution. Input agreement refers to the discussion of an input between independent contributors; if agreed upon, the input is deemed to be a quality contribution. Output agreement refers to contributors providing the same description for an input, both simultaneously and independently. Majority consensus is the decision, made by the majority of reviewers or validators, about a contribution being of the required quality. Contributor evaluation examines a contribution based on the quality of the contributor. Finally, real-time support is that which is provided to contributors, in real-time, to help ensure that the contributions are of the required quality.

As can be seen, some of these quality control methods overlap with the aforementioned ones proposed by, for example, Kittur et al. (2011). Allahbakhsh et al. (2013) also proposed a taxonomy of quality in crowdsourcing systems which details quality according to worker/contributor profile and task design. Figure 2 highlights this.

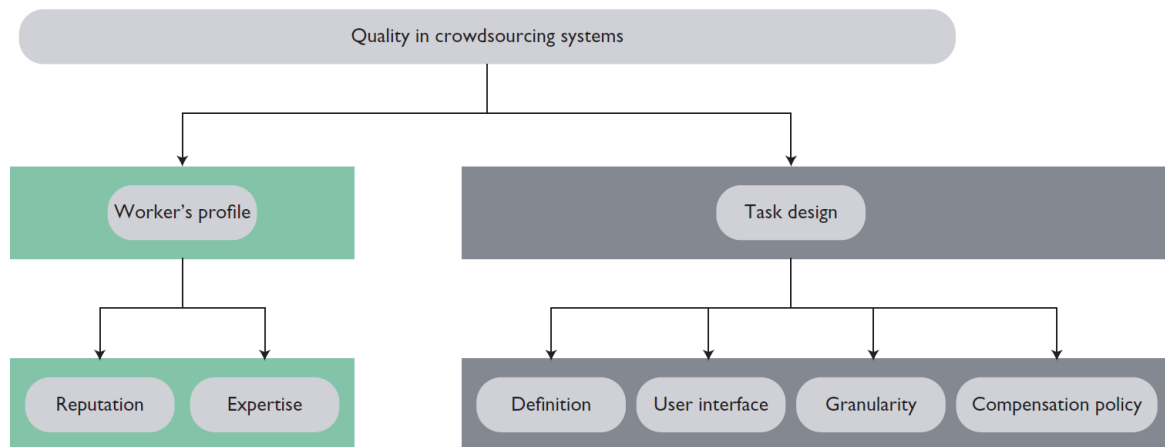


Figure 2 - Quality in crowdsourcing systems (Allahbakhsh et al., 2013, p. 77)

Hiltunen (2011) highlighted the importance of training as a component of an effective crowdsourcing system. The author explored the case of Finpro, an organisation that utilises crowdsourcing for its foresight activities, and argued that no foresight thinking can take place unless continuous and adequate training is provided to contributors; *“there can be no successful results in crowdsourcing without training”* (Hiltunen, 2011, p. 193). To ensure that effective training is in place, Finpro encourages every employee to make use of TrendWiki for sending signals and further discussing these contributions with clients; this also strengthens the relationship with clients and can foster new types of partnership. Also, employees are encouraged to better understand the foresight process as a whole. Hiltunen (2011) also made reference to the importance of providing feedback to contributors, and argued that, if employees do not receive feedback for their contributions, then long term participation is something that is unlikely; this provision of feedback to contributors is ensured by the discussion aspect of TrendWiki. Initial contributions are further engaged with by contributors commenting, refining or even challenging the contributions of others. Although not every signal contribution may be the object of discussion, at the very minimum, some engagement takes place due to the establishment of a voting system in which contributors vote on the value and strength of the contribution. J. Y. Moon and Sproull (2008) also emphasised the importance of feedback to sustain high-quality crowd contributions in crowdsourcing systems. Their study found that crowdsourcing systems that implement systematic quality feedback features engage better with contributors. Furthermore, contributors are more likely

to participate and the objectives of the crowdsourcing initiative are more likely to be met. They also found that the quality of contributions is also increased by systematic feedback.

In their study, Le et al. (2010) made an attempt to understand how training crowdsourcing contributors could impact the quality of crowdsourced data. They examined crowdsourcing tasks that require contributors to evaluate search results; the authors made reference to Amazon Mechanical Turk as one of the crowdsourcing systems that distributes such tasks. The authors explored the effects of a dynamic learning environment on the quality of crowdsourced contributions. The dynamic learning environment consisted of an initial training period and of the regular insertion of gold standard data, which was then evaluated (the gold standard data consisted of questions the answers to which were already known, and were aimed at seeing how contributors were performing). It was hypothesised that both contributor quality and aggregate majority vote result quality were enhanced through training data that uniformly distributed correct answers. The dynamic learning environment allowed for instant feedback; when wrong answers were chosen and mistakes made in the training data, contributors were informed. Quality and trust ratings were appropriated accordingly. Unethical or malicious contributors who constantly answered incorrectly were banned from returning. Specifically, the study argued that crowdsourcing systems that train contributors on relevance categorisation tasks improve the overall quality of data, therefore confirming the hypothesis.

Other scholars explicitly linked effective training with quality control and went into more detail in regard to training methods. For example, Poesio et al. (2013) argued for the importance of training and of the evaluation of contributors to ensure quality data for Phrase Detectives, an online crowdsourcing game that utilises the crowd to create anaphorically annotated resources. The Phrase Detectives crowdsourcing system recognises that complex information cannot be distributed to contributors outside of the actual playing of the game; therefore, training is provided during game play. A number of training mechanisms have been developed to provide contributors with helpful suggestions. This can be done in a variety of ways, including briefly detailing the main aspects of the game on the homepage, providing a full separate page of instructions showing aspects of the game in more detail, a FAQ section, further training tips provided during the game, and a small box on the player's homepage with hints and tips. To ensure relevance, these methods are constantly updated. Another

training mechanism highlighted by the authors is that of reinforcement, which is implemented through a validation mode. The validation mode assumes that decisions with which the majority of contributors will agree are deemed to be good. Basically, each contribution that has multiple interpretations goes through a validation process in which a number of contributor's state whether they agree or disagree with it. When a contribution is disagreed with, another one is allowed to be entered into the system; again, if there are multiple interpretations for the latter, it too goes through the validation process. Interestingly, the designers of the game assumed that validating a contribution would take longer than making one, but this was found not to be the case. Finally, the authors highlighted a training mechanism similar to that proposed by Le et al. (2010), in which contributors are asked to annotate text which has already been annotated, i.e. gold-standard text, which enables a comparison. The authors argued that this shows the willingness of contributors to play by the rules and further reveals whether they understand what is required of them. Contributors must successfully undertake a training text task both when first joining the game and to move to higher levels. After they have completed their training tasks, contributors are given a user rating, which can change over time. Significantly, contributors are continuously given training tasks until their ratings cross the 50% threshold; only then are they allowed to access real text. This is to ensure that malicious users and automated software are kept out.

In their exploration of the literature detailing the importance of quality control and of its effective management, Goodchild and Glennon (2010) highlighted the importance of crowdsourcing for humanitarian response during the four stages of a disaster; preparedness, response, recovery, and mitigation. Importantly, their study stressed that data quality issues pose a major concern in the use of volunteer geographic information (VGI) data, as there is an evident need to address questions of trust that are absent when obtaining geographic information from traditional sources. The authors stated that quality control methods are imperative for any crowdsourcing initiative, as is explicated by a comparison of Wikipedia and Wikimapia; whereas Wikipedia has effective quality control methods in place (e.g., peer-review), Wikimapia has none. Wikimapia's decline and Wikipedia's continual success are no accident. Gao, Wang, et al. (2011) highlighted the reasons behind the inadequacies of the existing humanitarian response crowdsourcing systems. Two of these reasons make reference to quality control—namely, security features and reliable information. The authors

argued that current crowdsourcing systems do not have sufficient security features. If crowdsourcing systems allow people to publicly access applications to add information, then the public is also able to view information. This can cause credibility and reliance issues that can create conflicts in the distribution of available resources, as various locations would be vying for them. The importance of quality control was also underlined by Erskine and Gregg (2012), who proposed a prototype for a real-time crowdmapping system.

2.3.2.2 Managing Motivation

Motivation is another research area that dominates the crowdsourcing literature and focuses on two main aspects. Firstly, it details the different motivations of contributors taking part in crowdsourcing initiatives. Secondly, the literature closely connects contributor motivations with the incentives that can be offered by crowdsourcing systems, as the latter can be tailored through the understanding of the former (*see table 2*). The conducted review highlights the prevalence of functionalist-based research; table 2 shows that, out of the 11 papers reviewed on motivation, eight were based on the functionalist-based approach, two were variance-based, one was interpretive-based and none were descriptive- or process-based. Such functionalist-based research identifies the different motivations exhibited by crowdsourcing contributors and typically proposes different incentives (occasionally through a model, framework or architecture) from which crowdsourcing systems could benefit, from the outset, to effectively manage the crowd and improve their output.

Table 2 - Motivation crowdsourcing literature

<u>Focus of Research Area</u>	<u>Type of Research (Descriptive/Functionalist/Variance/Process/Interpretive – see appendix 1)</u>	<u>Context (Commercial/Non-Commercial use of Crowdsourcing Systems)</u>
<p>Motivations of the crowd are detailed (intrinsic/extrinsic):</p> <p>- Intrinsic:</p> <p>- <u>Altruism</u> (Budhathoki and Haythornthwaite, 2013)</p> <p>- <u>Learning</u> (Brabham, 2008b, 2010; Budhathoki and Haythornthwaite, 2013; Leimeister et al., 2009)</p> <p>- <u>Personal enthusiasm/enjoyment</u> (Arakji and Lang, 2007; Brabham, 2008b)</p> <p>- <u>Self-marketing</u> (Leimeister et al., 2009)</p> <p>- <u>Love of community</u> (Brabham, 2010; Budhathoki and Haythornthwaite, 2013)</p> <p>- <u>Affinity for crowdsourcing initiative</u> (Brabham, 2010)</p> <p>- <u>Addiction</u> (Brabham, 2010)</p> <p>- <u>Peer recognition</u> (Brabham, 2008b)</p> <p>- <u>Reputation/status enhancement</u> (Arakji and Lang, 2007)</p> <p>- Extrinsic</p> <p>- <u>Monetary recompense</u> (Allahbakhsh et al., 2013; Brabham, 2008b, 2010; Leimeister et al., 2009)</p> <p>- <u>Nonmonetary prizes</u> (Leimeister et al., 2009)</p> <p>Motivation linked to incentives offered by crowdsourcing systems:</p> <p><u>Incentives offered (intrinsic/extrinsic):</u></p> <p>- <u>Access to knowledge of community, experts and mentors</u> (Leimeister et al., 2009)</p> <p>- <u>Career options</u> (DiPalantino and Vojnovic, 2009; Leimeister et al., 2009)</p>	<p><u>Descriptive:</u> -----</p> <p><u>Functionalist:</u> (Allahbakhsh et al., 2013; Arakji and Lang, 2007; Archak and Sundararajan, 2009; Blohm et al., 2013; Boudreau et al., 2011; DiPalantino and Vojnovic, 2009; Horton and Chilton, 2010; Leimeister et al., 2009)</p> <p><u>Variance:</u> (Brabham, 2008b; Budhathoki and Haythornthwaite, 2013)</p> <p><u>Process:</u> -----</p> <p><u>Interpretive:</u> (Brabham, 2010)</p>	<p><u>Commercial:</u></p> <p>- <u>Commercial use of crowdsourcing systems.</u> Systems include modified SAP systems, Threadless, iStockphoto, Amazon</p> <p><u>Mechanical Turk:</u> (Allahbakhsh et al., 2013; Arakji and Lang, 2007; Archak and Sundararajan, 2009; Blohm et al., 2013; Boudreau et al., 2011; Brabham, 2008b, 2010; DiPalantino and Vojnovic, 2009; Horton and Chilton, 2010; Leimeister et al., 2009; Riedl et al., 2010)</p> <p><u>Non-Commercial:</u></p> <p>- <u>Non-commercial use of crowdsourcing systems.</u> Systems include OSM: (Budhathoki and Haythornthwaite, 2013)</p>

<ul style="list-style-type: none"> - <u>Role and rights advancement</u> (Blohm et al., 2013) - <u>Profiling options</u> (Leimeister et al., 2009) - <u>Appreciation by peers and those organising</u> (Leimeister et al., 2009) - <u>Social status</u> (Boudreau et al., 2011) - <u>Working to targets</u> (Horton and Chilton, 2010) - <u>Monetary/nonmonetary rewards</u> (Allahbakhsh et al., 2013; Blohm et al., 2013; Boudreau et al., 2011; Brabham, 2010; DiPalantino and Vojnovic, 2009; Leimeister et al., 2009) 		
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Among the functionalist-based research on managing motivation, Leimeister et al. (2009) examined several motivation theories to make sense of and better understand crowdsourcing initiatives based on the competition of ideas. The authors stated that both intrinsic and extrinsic motivations play a role in a contributor’s decision on whether to participate in such initiatives. The authors further stated that user participation can be supported using the two-step MIAB model (Motives, Incentives, Activation and Behaviour). Their study found that user motivations combine with the incentives offered by the crowdsourcing initiative, which, in turn, supports activation, subsequently increasing contributor participation. The particular incentives identified by the authors include access to community, expert and mentor knowledge, career options, profiling options, the appreciation of peers and organisers, and monetary/non-monetary rewards.

In their study, Blohm et al. (2013) presented the challenges linked with implementing crowdsourcing systems. Importantly, they stipulated that incentives should be part of the implementation, and that they should be both extrinsic—in the shape of prizes—and intrinsic—in the shape of role and rights advancement.

Horton and Chilton (2010) developed what they called the labour supply model. This features a method for working out the lowest ‘wage’—called the workers reservation wage—that workers are willing to accept for their efforts during a crowdsourcing initiative. Their study implemented ideas from game theory and transaction cost theory, and found that workers

prefer working to targets. Acknowledging this, the authors stated that designers of crowdsourcing systems should take this worker preference into consideration when developing incentive systems, as natural targets tend to increase levels of output.

DiPalantino and Vojnovic (2009) used auction theory to better understand a crowdsourcing system—namely, a contest system that offers various incentives. The authors sought to capture and explain the relationship between participation and incentives within the crowdsourcing system, hence their use of auction theory. The authors articulated contests as ‘all-pay auctions’ and found that user participation levels increase with the incentives offered, while also identifying other factors that may impact user participation levels. In their study on crowdsourcing contests, Archak and Sundararajan (2009) also used auction theory to develop a model of a crowdsourcing contest. In terms of the proposed model, they stated that it is an all-pay contest model that encapsulates multiple incentives and ‘risk-averse’ wealth constrained contestants.

Boudreau et al. (2011) examined incentives and problem uncertainty within crowdsourcing innovation systems. Amongst other conclusions, the authors found that contest performance is increased with the number of contestants. Also, the importance of appropriate incentives in crowdsourcing systems was identified.

In an illuminating study into the differences between the intrinsic and extrinsic motivations in a crowdsourcing initiative, Arakji and Lang (2007) examined the case of the video game industry to show how its organisations have begun to open parts of their proprietary content to contributor development and transformation, therefore enacting a form of crowdsourcing. The study found that these organisations are successfully crowdsourcing game design and development aspects to contributor communities as a way to complement their products. Specifically, the authors found that intrinsic motivations are not always sufficient to engage contributors in a crowdsourcing initiative and questioned whether video game organisations should allow greater contributions by those with extrinsic motivations to ensure lasting contributions. In the chosen case, the intrinsic motivations of reputation and status enhancement, ego gratification and enjoyment of topical challenges only went so far. This was highlighted by the contributor community only completing 35% of certain started projects based on these intrinsic motivations and incentives. Nevertheless, the authors were

cautious in their suggestion that video game organisations should introduce extrinsic incentives as this may discourage collaboration, marginalise those with intrinsic motivations and eventually create social barriers; they suggested that extrinsic motivations can undermine intrinsic ones and eventually become dominant. A limitation of the study by Arakji and Lang (2007) has to do with the issue of time. Although not explicitly mentioned by the authors, the role of time is something that should not be ignored when arguing on the relative importance of intrinsic or extrinsic motivations. For example, if intrinsically motivated contributors are working on a task that is small, then it may be that their intrinsic motivation is sufficient for them to get through it or a number of similarly small tasks; however, if the task is much larger and requires more time, then extrinsic incentives may come into play, as extrinsic motivations are needed by contributors to keep them contributing in the long run. Furthermore, the difference in motivational factors for contributors surely depends on the context of a crowdsourcing initiative; this was also briefly mentioned by Zhao and Zhu (2014). For example, the contributors to an ideas competition crowdsourcing initiative that provides extrinsic incentives are far likely to be extrinsically motivated than those adding to a pro-social crowdsourcing initiative, who are far more likely to be intrinsically motivated.

2.3.2.3 Assessing Outcomes

Outcomes is another research area that dominates the crowdsourcing literature. This literature focuses on the different ways in which crowdsourcing has been utilised (*see table 3*). Table 3 shows that, out of the 24 papers reviewed on outcomes, nine were descriptive-based, six were functionalist-based, six were variance-based, one was process-based and two were interpretive-based. The functionalist-based literature on outcomes goes beyond other types of research, as it typically assesses outcomes at the endpoint of a crowdsourcing initiative, and proposes ways (occasionally through a model, framework or architecture) in which crowdsourcing outcomes could be better organised, managed, and, ultimately, improved from the outset.

Table 3 - Outcomes crowdsourcing literature

<u>Focus of Research Area</u>	<u>Type of Research (Descriptive/Functionalist/Variance/Process/Interpretive – see appendix 1)</u>	<u>Context (Commercial/Non-Commercial use of Crowdsourcing Systems)</u>
<p><u>Outcomes of crowdsourcing systems are detailed:</u></p> <p>- <u>Creativity and design ideas</u> (Arakji and Lang, 2007; Bayus, 2013; Brabham, 2008b, 2010; Leimeister et al., 2009; Nickerson et al., 2011; Poetz and Schreier, 2012; Ren, 2011)</p> <p>- <u>Problem solving</u> (Afuah and Tucci, 2012; Brabham, 2008a; Franklin et al., 2011; Savage, 2012)</p> <p>- <u>Public participation</u> (Brabham, 2009; Goolsby, 2010; Heinzelman and Waters, 2010; Majchrzak and More, 2011; Palen et al., 2007; Palen and Liu, 2007; Sutton et al., 2008; Yates and Paquette, 2011; Zook et al., 2012)</p> <p>- <u>Innovation</u> (Majchrzak and Malhotra, 2013; Riedl et al., 2010)</p> <p><u>Arguments for the transformational power of crowdsourcing:</u> (Doan et al., 2011)</p>	<p><u>Descriptive:</u> (Brabham, 2008a, 2009; Goolsby, 2010; Heinzelman and Waters, 2010; Majchrzak and More, 2011; Palen et al., 2007; Palen and Liu, 2007; Savage, 2012; Zook et al., 2012)</p> <p><u>Functionalist:</u> (Arakji and Lang, 2007; Doan et al., 2011; Franklin et al., 2011; Leimeister et al., 2009; Majchrzak and Malhotra, 2013; Nickerson et al., 2011)</p> <p><u>Variance:</u> (Afuah and Tucci, 2012; Bayus, 2013; Brabham, 2008b; Poetz and Schreier, 2012; Ren, 2011; Riedl et al., 2010)</p> <p><u>Process:</u> (Yates and Paquette, 2011)</p> <p><u>Interpretive:</u> (Brabham, 2010; Sutton et al., 2008)</p>	<p><u>Commercial:</u></p> <p>- <u>Commercial use of crowdsourcing systems.</u> Systems include Amazon Mechanical Turk, Threadless, iStockphoto, Dell IdeaStorm, InnoCentive, Goldcorp, CrowdDB: (Afuah and Tucci, 2012; Arakji and Lang, 2007; Bayus, 2013; Brabham, 2008a, 2008b, 2010; Doan et al., 2011; Franklin et al., 2011; Leimeister et al., 2009; Majchrzak and Malhotra, 2013; Nickerson et al., 2011; Poetz and Schreier, 2012; Ren, 2011)</p> <p><u>Non-Commercial:</u></p> <p>- <u>Non-commercial use of crowdsourcing systems.</u> Systems include OSM, Foldit, Ushahidi, Humanitarian based systems: (Brabham, 2009; Doan et al., 2011; Goolsby, 2010; Heinzelman and Waters, 2010; Majchrzak and More, 2011; Palen et al., 2007; Palen and Liu, 2007; Savage, 2012; Sutton et al., 2008; Yates and Paquette, 2011; Zook et al., 2012)</p>

Among the functionalist-based literature on assessing outcomes, Nickerson et al. (2011) explored how crowdsourcing can be used for creativity and design purposes. The authors presented a sequential combination system, which is a human based genetic algorithm, devised to organise the crowd for design based initiatives. Genetic algorithms have limitations in that, to be productive, there have to be clear objective function and solution representations; utilising humans as computing nodes can overcome these limitations. This having been said, the resultant human based genetic algorithms that overcome these limitations require the use of large numbers of people—namely the crowd, and this is where crowdsourcing comes into play; proliferating web-enabled human based genetic algorithms.

These algorithms utilise the crowd for combining two ideas whilst using the computer to manage the workflow. The authors utilised this approach for two projects.

In the first, the crowd was asked to design solutions for the Gulf of Mexico BP oil spill; 1853 contributors participated, creating, combining and evaluating design solutions. The project found the best ideas generated by the crowd to be just as good as those produced by the experts, therefore highlighting the calibre of the crowd. The experiment was broken into three 'generations'. In generation one, one crowd produced text ideas, while another evaluated those ideas, and tournament selection was based on the evaluation to select 'parent pairs' of ideas. During generation two, another crowd 'formed offspring' by combining the 'parent pairs' and, during generation three, the process was repeated to collect their ideas. The whole idea of using the combination method was to improve levels of creativity, as articulated by the authors.

In the second project, the authors asked the crowd to present design ideas, through sketches, for consumer products. Again, as with the first project, the crowd was assigned different roles; creating, combining and evaluating design solutions. The first product involved designing a chair for children whilst the second involved designing an alarm clock. It was found that, for both the chair and clock, generation three produced a greater number of creative designs than generation one.

In their study, Franklin et al. (2011) explored the use of crowdsourcing for problem solving. The authors stated that this type of crowdsourcing is especially useful in those cases in which computers are not suitable for answering queries. In such cases and in addition to more computationally problematic tasks, the crowd can be utilised for tasks that include matching, ranking and aggregating results. The authors explored the crowdsourcing system of CrowdDB, which utilises the crowd to answer queries that cannot be adequately answered by search engines and database systems. Their study presented the design of CrowdDB and hypothesised that crowdsourcing can be effectively used to answer queries that are outside the capabilities of computers. Through an experiment involving 718 contributors and 25,817 assignments, the authors found the hypothesis to hold. Challenges were also identified relating to result quality, response time, and cost.

Majchrzak and Malhotra (2013) emphasised how crowdsourcing is increasingly being leveraged for innovation purposes; the authors emphasised open-innovation, as crowdsourcing for innovation is not something new. The authors stated that IS should not be just viewed as an enabler of open-innovation, but also as a shaper that optimises crowdsourcing and open-innovation. The authors presented examples of crowdsourcing systems used for innovation; IBM innovation Jams, Lego mindstorms, General Electric Ecolmagination. Three tensions that crowdsourcing systems need to consider when developing their architectures were also highlighted; the first one being that, while idea evolution takes lots of time, contributors tend to spend only a small amount of it, the second is that encouraging concurrent collaboration and competition poses a challenge, and the third is that creativity requires contributor familiarity, whereas the crowd is, more often than not, made up of strangers.

2.3.3 Crowd-Action Perspective

As mentioned, out of the 24 papers reviewed on outcomes, nine were descriptive-based. By describing a particular crowdsourcing initiative, descriptive-based research highlights how crowdsourcing is bringing change to different contexts—e.g., humanitarian response (*see table 3*). This research serves an important purpose in that it illustrates the importance of crowdsourcing and the role of the crowd. This standpoint is in sharp contrast to that of the functionalist-based literature, which conceptualises the crowd as controlled and managed, through typically presenting a model, framework or architecture in regard to achieving this. This having been said, descriptive-based research tends to be limited to description and does not present an in-depth analysis of the change taking place. Furthermore, it tends to provide a one-sided view of change as something that occurs only through the action of the crowd.

Among this descriptive-based research, which illustrates the role of the crowd, Savage (2012) detailed how a crowdsourcing initiative allowed scientists to solve a problem, the solution to which had evaded them for more than a decade. Scientists at the University of Washington were struggling to discover the protein structure that helps the human immunodeficiency virus multiply; understanding this structure would enable them to create drugs to attack the virus. The lack of breakthroughs in understanding the structure had led them to turn to a crowdsourcing initiative called Foldit; an online game that challenges contributors to rearrange proteins into their lowest energy form. Remarkably, what scientists had failed to

unravel in over a decade was solved within three weeks by 57,000 contributors with no specific training in molecular biology. The University of Washington stated that this was most likely the first instance of a longstanding scientific problem being solved by crowdsourcing. The author also highlighted how a crowdsourcing game developed by assistant professors at McGill University is allowing geneticists to align DNA sequences, progressing studies into genetic diseases. Phylo had been launched towards the end of 2010 and Savage (2012) stated that, by 2012, more than 35,000 contributors had played the game, improving 70% of the alignments distributed to them. The above two examples highlight how crowdsourcing has been used for problem solving. Curiously, the study by Savage (2012) makes no mention of the potential longstanding effects of crowdsourcing on the scientific field; where Foldit and Phylo represent two excellent cases of science utilising crowdsourcing for problem solving, further exploration of crowdsourcing and of the changes it had brought to the scientific field would have further illuminated its impact.

Brabham (2009) argued that crowdsourcing can be effectively used for public participation. Specifically, the author argued that the crowdsourcing model can effectively enable public participation in urban planning projects. The author detailed the theories of crowd wisdom and collective intelligence in support of the argument that crowdsourcing is an effective way of 'harnessing far-flung genius'. Brabham (2009) did not conduct any empirical investigation to back up these claims; rather, he conducted what is described as a 'visioning exercise', in which it is imagined that crowdsourcing will be utilised for planning a new neighbourhood development. Therefore, the case involves a city planning commission being proposed a hypothetical neighbourhood development project. Subsequently, the commission launches a public participation program to identify the impact of the proposed development on the community and to provide solutions for any identified problems. The author highlighted the steps that the city planning commission would undertake to engage the public and went on to emphasise how crowdsourcing would benefit this. He stated that crowdsourcing would enable all citizens to participate regardless of their position in society—and the politics associated with that position—and of their ability to attend meetings. Moreover, the contributors' participation level would be entirely down to them; this would also cater for different roles as some contributors would be interested in contributing suggestions whilst others would be more interested in evaluating them. The author went on to highlight various

challenges to crowdsourcing and public participation—namely, the digital divide, internet availability and crowd resistance.

Palen et al. (2007) detailed the use of crowdsourcing—specifically, citizen-led online forums—during the 2005 Hurricane Katrina and the 2003 California wildfires. The authors also highlighted how such forums were used for the avian flu preparation programme in the United States. Importantly, the study highlighted that there is a shift in disaster situations that sees local citizens increasingly becoming the true first responders. Furthermore, the study made a significant recommendation for humanitarian organisations to be able to incorporate and utilise public participation during disaster situations. This argument was bolstered with positive examples of public participation taken from the aforementioned disasters.

Palen and Liu (2007) further argued that, due to the increasing role played by ICTs, public participation is an emerging area within humanitarian response, resulting in implications for both informal and formal response. Specifically, the authors presented three information pathways in humanitarian response resulting from the heightened use of ICTs; increasing communication between those affected by a disaster, increasing communication between those affected by a disaster and those on the outside, and increasing recursive communication between public information officers and the public. Importantly, the study pointed out how formal humanitarian response models are unable to account for public participation; *“ICT in disaster contexts will give further rise to improvised activities and temporary organizations with which formal response organizations need to align”* (Palen and Liu, 2007, p. 727).

In an interpretive-based study, Sutton et al. (2008) questioned the victims of the 2007 California wildfires on their use of ICTs during the disaster. Significantly, the study found that many of those affected had given up on mainstream information sources and had instead relied on crowdsourced information. This led the authors to argue that crowdsourced data are beginning to gain increasing prominence during disaster situations, despite the concerns expressed by official humanitarian actors about the legitimacy of such data. Similar to Palen and Liu (2007), the authors further argued that this increasing prominence would potentially bring change to humanitarian response, with humanitarian organisations having to be able to

accommodate crowdsourced data. The study also emphasised how the crowdsourced activities during the wildfires were ‘strikingly well organised’.

In their study, Majchrzak and More (2011) highlighted the case of the 2007 San Diego fires and of how crowdsourcing was utilised to benefit the humanitarian response during the disaster. The authors highlighted how Google Maps was used to detail information such as fire perimeters, evacuation centres, evacuation routes and first-aid locations. The developed maps were accessed by people all around the world and 1.5 million hits were recorded within just two days. Overall, the authors articulated how the San Diego fires illustrate the value of crowdmapping. Writing about the contributors or crowdmappers, the authors stated that *“harnessing this collective wisdom is a laudable goal for future emergency-response systems”* (Majchrzak and More, 2011, p. 132). The authors highlighted three key insights: crowdsourcing through web 2.0 technologies enables emergent contributor networks to assist humanitarian response; the effectiveness of these contributor networks depends on their organisation and technical infrastructure; and crowdsourcing tools can provide means for contributions to be coordinated.

Heinzelman and Waters (2010) explored how crowdsourcing was used during the 2010 Haiti earthquake. In particular, the Ushahidi crowdmapping platform enabled participants to send reports through SMS, MMS or the online platform, which would then be mapped; this also resulted in text based reports being geo-tagged with the help of a group of volunteers. These rapid updates enabled emergency teams to effectively respond to the most crucial cases—including medical emergencies and trapped persons—and to other specific requests—such as water and food shortages. Goolsby (2010) described how Ushahidi was utilised during the Haiti earthquake. Highlighting the positive role played by this crowdmapping platform, the author stated that it enabled the drawing of detailed maps of Haiti that would have been unavailable without the efforts of contributors. In their study, Zook et al. (2012) explored the use of crowdmapping tools during Haiti. Again, highlighting the positive role played by crowdmapping, the authors stated that crowdmapping was *“a key means through which individuals could make a tangible difference in the work of relief and aid agencies without actually being physically present in Haiti”* (Zook et al., 2012, p. 7). Furthermore, the authors stated that crowdmapping during Haiti represented *“a remarkable example of the power and*

crowdsourced online mapping and the potential for new avenues of interaction between physically distant places that vary tremendously” (Zook et al., 2012, p. 7).

2.4 The Process of Crowdsourcing (Process vs. Variance)

The current state of the crowdsourcing literature highlights that there is limited process-based research, as authors have more readily adopted the variance-based approach to study the crowd. This is consistent with the organisational perspective, as the variance-based research, on occasion, proposes a model or framework. The lack of process-based research means that ideas of emergence, evolution and formation are not considered by the literature, as existing research tends to focus on the outset or endpoint position of crowdsourcing initiatives. For example, controlling output quality and managing motivation consider crowdsourcing initiatives more from the outset, whilst assessing outcomes considers initiatives more from an endpoint. Variance and process-based studies, as per the literature, are now explored.

With regard to controlling output quality, Riedl et al. (2010) undertook a variance-based study that offers an insight into how different idea selection rating mechanisms operate within online communities that exhibit innovation. The authors argued that the rise of crowdsourcing systems has led to user-generated ideas in their thousands; due to these large numbers, a rating mechanism is suited to identify the best ideas. The rating mechanism can be seen as a quality control method in that contributors, in a way, vote for what they think are the best ideas or contributions. The study measures participant rating satisfaction and concludes that simple rating mechanisms are not accurate in producing valid idea rankings. The authors further promoted a multi-attribute scale that outperforms simple rating mechanisms. Whereas the latter include the thumbs-up/thumbs-down and the simple star rating approaches, the more complex mechanism proposed includes four 5-star scales. The four rating attributes include: novelty—which asks contributors how novel they think an idea is; value—which asks contributors to rate the potential value an idea would have if implemented; feasibility—which asks contributors how easy they think an idea would be to implement; and elaboration—which asks contributors how well they think an idea was elaborated. The limitations of the study stem from the fact that it was a controlled experiment. Its representativeness of real life behaviours can be questioned because, during the experiment, contributors had to rate all the ideas whereas, in a real life scenario,

contributors would have had the choice of which ideas to rate. In those cases, in the study in which contributors may not have known much about a certain idea, they still had to rate it, and no neutral rating value was provided to try to counteract this.

In regard to managing motivation, Brabham (2008b) undertook a variance-based approach to examine the iStockphoto community (now called iStock, having been acquired by Getty Images). Initially, iStockphoto was a free stock imagery website, but has since adopted a micropayment model. iStockphoto contributors, essentially a community of amateur photographers, upload visual content, including animations, stock images, and video clips, to the website. Those interested in the content can purchase it, with both iStockphoto and the uploaders gaining extrinsically. In essence, iStockphoto solves the issue or problem of sourcing affordable stock imagery; a crowdsourced open call is made and contributors answer this by uploading visual content, therefore solving the problem. Brabham (2008b), tested the hypothesis that iStockphoto contributors are more likely to be mainly motivated by the chance to learn new skills and attain peer recognition. The results indicate that the hypothesis was only moderately supported. This is because it was found that the extrinsic monetary gain motivation was actually the most central amongst contributors, followed closely by the motivation of enjoyment in contributing. Interestingly, the author also found that contributors were not motivated by the establishment of a network with other contributors. The findings related to the iStockphoto community very much highlight the diversity of motivations found among contributors to different crowdsourcing initiatives.

In a similar study—this time, an interpretive-based one—Brabham (2010) explored the Threadless crowdsourcing initiative, which had been described by Howe (2006a) as an example of *“pure, unadulterated (and scalable) crowdsourcing”*. Threadless is an online clothing company that crowdsources designs for its t-shirts through online competitions. Design contributions are rated on a five-point scale by a community of contributors. The t-shirts designs that are rated the highest are then manufactured and made available for purchase on the company’s website. Notably, Threadless offers extrinsic incentives to those contributors whose designs are selected, with prizes consisting of \$500 Threadless gift certificates and \$2000 in cash. The study identifies five motivations behind contributor participation: love of the Threadless community; the chance to undertake freelance work; the chance to develop creative skills; addiction; and the opportunity for monetary gains. It can be

seen that the first four are intrinsic motivations, while the last is an extrinsic one. As the author made the call for contributors to participate through the Threadless community blog forum, the identified intrinsic 'love of the Threadless community' and 'addiction' motivations can be seen to be somewhat unsurprising and expected, which perhaps distorts the representation of the wider Threadless contributor community. The study did not recruit contributors through others means.

In regard to assessing outcomes, Poetz and Schreier (2012) undertook a variance-based study that explores the effectiveness of crowdsourcing in generating new product ideas. The authors conducted an interesting experiment in which, on the basis of three key quality dimensions—novelty, feasibility and customer benefit—they compared crowd generated new ideas with others put forward by professionals with regard to making more comfortable the experience of feeding babies mash and solid foods. Novelty referred to how unique an idea was in comparison with similar existing products. Feasibility referred to how easily an idea could develop into a commercial product, both in economic and technical terms. Customer benefit referred to how efficient a product was in addressing the issue presented. Once the product ideas submitted by both the crowd and the professionals had been developed, they were presented to the executives of a target organisation. Interestingly, the study found that crowdsourced ideas scored significantly higher in terms of novelty and customer benefit, but lower with regard to feasibility. This having been said, the average feasibility values tended to be relatively high, in sharp contrast to those pertaining to novelty and customer benefit. The authors then argued that, as crowdsourced ideas scored higher in terms of novelty and customer benefit, the lower feasibility score was not representative of a bottleneck. The fact that the novelty and customer benefit dimensions were higher would be enough for the crowdsourced ideas to be considered for manufacturing. In essence, it was found that the best ideas were developed by the crowd, not by the professionals.

This having been said, other crowdsourcing studies that looked at new product ideas were not as positive. For example, Bayus (2013) explored individual ideation efforts within a crowdsourcing system and how these impacted an online community. The author aided this understanding through cognitive fixation theory and structured imagination theory and detailed the negative effects of past success in such systems, which saw the 'ideators' continually proposing ideas that were similar to the original one they had contributed, despite

attempting to come up with new ones. Overall, the challenges linked to consistently producing quality ideas within a crowdsourcing system were highlighted.

Still in relation to assessing outcomes, Afuah and Tucci (2012) undertook a variance-based study and argued that crowdsourcing can improve problem solving effectiveness and efficiency for organisations. The authors argued that this is the case when crowdsourcing transforms distant search into local search; when this occurs, an organisation's problems may be better solved through the crowd rather than internally. The authors made use of organisational behavioural and evolutionary theories to identify the instances in which crowdsourcing could be a more suitable problem solving mechanism than the alternatives of relying on internal resources or hiring external contractors. The authors detailed the conditions under which crowdsourcing is better suited: the knowledge required, the characteristics of the problem, the capabilities of the crowd, and the evaluation of solutions. 'Knowledge required' refers to those cases in which the 'typical neighbourhood' of the organisation cannot provide adequate expertise, therefore bringing about the need for distant search. 'Characteristics of the problem' refers to the ability to easily disseminate the problem to the crowd. 'Capabilities of the crowd' refers to the dynamics of the crowd and to whether it is sufficiently knowledgeable, motivated and large to tackle the problem. Finally, 'evaluation of solutions' refers to how easy and manageable the solutions are for appraisal and adoption by an organisation. Interestingly, the authors also made reference to the actual technological capabilities of crowdsourcing, mentioning another important condition is the low cost of the technology. The study carried out by Afuah and Tucci (2012) is important because it highlights the conditions under which organisations may seek to call upon the crowd for problem solving purposes. However, one of its limitations concerns the assumption, made by the authors, that an organisation has only three avenues available to solve its problems—namely, internally, through an external contractor, or through the crowd. This excludes other methods, such as actively working with another organisation or a group of individuals.

Yates and Paquette (2011), undertook a process-based study that, through action research, was aimed at understanding how crowdsourcing was utilised during the 2010 Haiti earthquake. The authors joined the United States Air Force Crisis Action Team (AFCAT) for a two week period and found that crowdsourcing through social media holds great promise in

assisting public participation in disaster management; this finding is similar to those of scholars such as Palen et al. (2007) and Sutton et al. (2008). Interestingly, the authors stated that the *“information currency of disaster response is increasingly text messages, images, short videos, blog posts, and web links – all encapsulated knowledge chunks”* (Yates and Paquette, 2011, p. 7). Specifically, the authors argued that social media tools allow the tapping of more complete knowledge resources and also increasingly support faster decision cycles.

2.5 Assessment of Literature

The above sections highlight the two different standpoints found within the literature regarding the crowd. The majority of the literature, represented by functionalist-based research, focuses on ways in which the crowd could be better organised or managed, whilst the descriptive-based literature illuminates the role of the crowd and the impact that it can have. It becomes apparent that the overall literature is inclined towards the organisational perspective, downplaying crowd-action one. This contrast in the literature highlights an opportunity for research that considers both organisational and crowd-action aspects. Moreover, the contrast between the organisational and crowd-action perspectives highlights a bigger debate within IS, which is that of structure vs. action (Orlikowski, 1992). It can be said that the organisational perspective represents a structure viewpoint, whilst the crowd-action perspective represents an action viewpoint. Due to the scarcity of research that considers both perspectives, the crowdsourcing literature, in its present state, fails to provide an in-depth account of the change that the phenomenon can deliver. Furthermore, from the review of the process-based vs. variance-based research, it becomes apparent that the former is something of a rarity; therefore, there is limited understanding of the process of crowdsourcing. In addition, there is a lack of in-depth interpretive-based research. The lack of in-depth research is further highlighted by the minimal theoretical engagement of the crowdsourcing literature, as highlighted by table 4. Theoretical maturity is one sign of a research area being well developed, and it is evident that this is not the case with the crowdsourcing literature. Out of the 47 studies reviewed, only 11 utilise or even make brief mention of theory. Where theory is utilised, there is limited use of a social-based theoretical foundation. This study argues that, because crowdsourcing is a social phenomenon, it would be better explored through the lens of a social-based theory.

Table 4 - Crowdsourcing literature that utilises theory

Author	Theories Used
(Brabham, 2008a)	Wisdom of crowds theory
(Leimeister et al., 2009)	Motivation theories
(Afuah and Tucci, 2012)	Organisational behavioural and evolutionary theories
(Archak and Sundararajan, 2009)	Auction theory
(DiPalantino and Vojnovic, 2009)	Auction theory
(Horton and Chilton, 2010)	Game theory and transaction cost theory
(Riedl et al., 2010)	Wisdom of crowds theory
(Poesio et al., 2013)	Game design theory
(Ren, 2011)	Componential theory of creativity
(Bayus, 2013)	Cognitive fixation theory and structured imagination theory
(Brabham, 2009)	Wisdom of crowds and collective intelligence theories

The next chapter explores the theoretical foundation adopted by this study. Taking the current state of the crowdsourcing literature into consideration, it adopts structuration theory as the theoretical lens through which to conceptualise and make sense of the collected data. In these circumstances, structuration theory is particularly useful because of its balanced view of structure and action (structuration theory refers to action as ‘agency’). The use of structuration theory addresses the gap in the literature because of its apt consideration of both structure and agency.

2.6 Summary of Chapter

In summary, this chapter conducts a critical review of the crowdsourcing literature. It begins by arguing how advancements in digital infrastructures and social computing have resulted in the proliferation of crowdsourcing. It then presents two different perspectives that the literature review made evident—namely, the organisational and crowd-action perspectives. It then provides an assessment of the current literature, in which it is argued that, in its present state, the literature fails to provide an in-depth account of the change that the phenomenon can deliver; this is because the existing literature leans towards the organisational perspective, downplaying the role of the crowd and its potential impact. The review presents an opportunity for this study to take on a particular form—namely, a process-based interpretive approach that theoretically engages with the crowdsourcing phenomenon,

considering both structure and action elements (organisational and crowd-action perspectives).

Chapter Three: Theoretical Foundation

This chapter reviews the various theoretical perspectives explored by this study. The author began by reading on theories that generally deal with change, and specifically, social and technological change. This chapter presents those critically explored theories—namely, Structuration Theory, Theory of Practice, Actor Network Theory (ANT), the Technology Acceptance Model (TAM), and the Punctuated Socio-Technical Information Systems Change (PSIC) Model. The chapter focuses considerably more on structuration theory developed by Giddens (1984), as this was the theoretical foundation adopted by this study (the justification for this adoption is detailed in section 4.5). The chapter contains nine sections; the first examines structuration theory in detail— covering its core elements, including the concepts of the duality of structure, agency and dialectic of control, knowledgeability and reflexivity, structure, and the modalities of structuration model, which Giddens identified and explained to provide a better understanding of his conceptualisation of agency and structure. The second section explores the theory of practice, detailing the concepts of the habitus, field and doxa. The third section explores ANT, and its central concepts—including actor, actor-network, translation, problematisation, obligatory passage point, interessement, enrolment, inscription, delegates, betrayal, irreversibility, and black-box. The fourth section explores TAM, while the fifth explores the PSIC model. The sixth section explains and justifies the adoption of structuration theory by this study. The seventh section explores the application of structuration theory within the IS discipline, while the eighth presents the conclusion, arguing that the IS discipline can still gain considerably from going back to the original formulation of structuration theory. The ninth and final section presents a summary of this chapter.

3.1 Structuration Theory

Giddens began the development of structuration theory in the late '70s with works that include *'New Rules of Sociological Method'*, *'Functionalism: après la lutte'*, and *'Central Problems in Social Theory'*. His work on structuration theory culminated in 1984 with *'The Constitution of Society – Outline of the Theory of Structuration'*, which Giddens described as being the summation of his previous writings on structuration theory. The theory was developed in an attempt to overcome what Giddens regarded as deficiencies in social analysis—namely, positivism and strong interpretivism. Giddens argued that both these

approaches did not accurately represent human agency, as the former placed an excessive emphasis upon structure, while the latter did not stress it enough; this conclusion was partly reached through a critical analysis of the works of leading structuralists and phenomenologists, including Goffman and Garfinkel, which set the scene for Giddens's introduction and development of the concepts of structuration theory (Giddens, 1984; Jones and Karsten, 2008; Stinchcombe, 1990). Giddens heralded a move away from epistemological issues and towards more ontological concerns in social theory. He argued that, by focusing upon epistemological issues, such as the nature of appropriate forms of knowledge, social theory did not sufficiently focus upon ontological issues, as structuration theory predominantly does. In outlining the aims of structuration theory, Giddens argued that social theory should be concerned *"first and foremost with reworking conceptions of human being and human doing, social reproduction and social transformation"* (Giddens, 1984, p. xx). The central issue that structuration theory is aimed at tackling is the relationship between social agents and society. Craib (2011), explained that structuration is about the *"production, reproduction and transformation of structures"* (Craib, 2011, p. 44).

By rejecting both positivism and strong interpretivism, Giddens signalled a move away from understanding structure and agency as a dualism, and towards understanding them as a duality by proposing that they are mutually constitutive. Structure and agency are mutually not independent of each other; social agents draw upon structure when they act, while their actions, at the same time, serve as a basis upon which social structure is produced or reproduced. This should not be taken to infer that change is not possible, as Giddens viewed social agents as being knowledgeable and reflexive, and having the capability of transforming structure. Social agents always have the ability to act otherwise, as all forms of dependency offers resources that can be used to influence; in structuration theory, this is what is called the dialectic of control. Furthermore, whilst making distinction between unintended and intended actions, structuration theory also emphasises that unintended consequences can occur just as frequently as intended ones, (Giddens, 1984, 1990).

3.1.1 The Duality of Structure

The structure vs. agency dichotomy remains the subject of major debate within the social sciences and is fraught with conceptual complexities, as was acknowledged by Giddens; *"the*

attempt to formulate a coherent account of human agency and of structure demands . . . a very considerable conceptual effort” (Giddens, 1984, p. xxi).

The structure vs. agency debate centres upon two main perspectives which were articulated in detail by Dawe (1978), who replaced the words ‘structure’ and ‘agency’ with ‘system’ and ‘action’, respectively; *“in a sociology of social system, then, social actors are pictured as being very much at the receiving end of the social system. In terms of their existence and nature as social beings, their social behaviour and relationships, and their very sense of personal identity as human beings, they are determined by it. The process is one whereby they are socialised into society’s central values and into the norms appropriate to the roles they are to play . . . Social action is thus entirely the product and derivative of social system. In total opposition to this, a sociology of social action conceptualises the social system as the derivative of social action and interaction, a social world produced by its members, who are thus pictured as active, purposeful, self and social creative beings” (Dawe, 1978, pp. 366-367).*

Giddens’s position on this debate was critical of the structural/functionalist school of thought, which, he argued, views structure too strongly and agency too weakly, whilst also being critical of the strong interpretive school of thought, which views agency too strongly and structure too weakly; this led to him to criticise sociologists, including Goffman, Garfinkel and Schutz. Giddens’s account of the reproduction of institutional practices provided the basis for his reconciliation of structure and agency. At the time, his critique of both the structural/functionalist and strong interpretive schools of thought and his development of the duality of structure represented a dramatic departure from the then prevailing theories of action and structure. Giddens denied both determinism and the unbounded freedom or strong interpretivism in two ways, amongst others. Firstly, Giddens argued that every social relationship or situation provides social agents with a dialectic of control that can result in an uneven access to or manipulation of the resources through which social agents can influence others; no action in which social agents engage is ever completely autonomous. Secondly, the degree of freedom possessed by social agents depends on how skilled they are, and, as no one social agent is fully skilled in all the social situations in which they participate, their freedom has limitations (Giddens, 1984, 1990). This explanation enables structuration theory to sit in the middle of the debate; *“the conception of agency in structuration theory resists the*

polarities of both a thoroughgoing determinism and unqualified freedom, while preserving all possibilities between the polar extremes” (Cohen, 1989).

Structuration theory attempts to avoid the asymmetrical view of structure and agency by arguing that they are mutually constitutive. Structure and agency are equally important because they are mutually not independent. Social agents draw upon structures when they act; at the same time, their actions serve as a basis for the structures’ production or reproduction. Both perspectives are reconciled through the duality of structure, which was developed based upon the argument that neglecting the reproduction of regularities in social practice makes it not possible to understand how lasting structural properties are developed and sustained, while neglecting structural properties makes it not possible to understand the conditions necessary for social agents to produce such regularities. Social agents reproduce systematic articulations and actions over space and time, which, at the same time, generate the knowledge of practices that is required to reproduce them. The duality of structure refers to *“the essentially recursive character of social life: the structural properties of social systems are both the medium and outcome of the practices that constitute those systems”* (Giddens, 1982, pp. 36-37). Routine, which is whatever is done in a habitual manner, is the basic element of daily life. When the activities carried out by social agents become repetitive, they provide what Giddens argued to be the material grounding for the recursive nature of social life. Social life becomes recursive through the structured properties of social activity, becoming constantly recreated out of the resources that constitute them; this occurs through the duality of structure (Giddens, 1984, 1993).

To further clarify and explicate the duality of structure, Giddens referred to the Saussurian notion of the production of an utterance. In order to utter a sentence, social agents draw upon a variety of syntactical rules. The structural features of a language are the medium by which social agents generate utterances. By producing a syntactically correct utterance, a social agent contributes to the reproduction of the language as a whole; this elucidation also clarifies Giddens’s notion of structure as not only being constraining, but also enabling (Giddens, 1982, p. 37). Giddens further argued that structuration is not only involved in reproduction, as per the language example, but also in the most radical and revolutionary forms of social change (Giddens, 1984, 1990; Parker, 2000). This was further clarified by Roberts and Scapens (1985), who stated that *“through being drawn on by people, structures*

shape and pattern (i.e., structure) interaction. However, only through interaction are structures themselves reproduced. This is the 'duality of structure'; it is in this way that structures can be seen to be both the medium and the outcome of interaction" (Roberts and Scapens, 1985, p. 446).

A major criticism of the duality of structure is centred upon the idea of the conflation of structure and agency. Conflation occurs when structure is reduced to agency or vice versa, making it difficult to separate one from the other.

Barley and Tolbert (1997) stated that, if institutions cannot be separated from activity, the two are not analytically or phenomenologically distinct, which makes it difficult to understand how one affects the other.

Archer (1996) argued that the conflation of structure and agency weakens their analytical power and prevents the examination of their interplay, making it difficult to understand the relative importance of structure or agency at a particular moment in time, how they interact with each other and, what the consequences of their interaction are. She gave an example of how this is prevented by the duality of structure; by breaking down the everyday mutually constitutive term 'riding', it can be seen that horse and rider possess different properties, some of which are relevant to 'riding', while others are not (the rider's weight is relevant, while the horse's colour is not). The duality of structure withholds each element's autonomy, meaning that their intimate mutual influences cannot be needed out. The duality of structure does not acknowledge that structure and agency operate at different times, with either short or long gaps between them. This means that the two most important points made by the dualistic approach are not incorporated theoretically; firstly, that structural features predate the actions that transform them and, secondly, that structural elaboration postdates those actions.

To tackle these deficiencies in structuration, Archer proposed a morphogenetic approach involving an analytical dualism, and argued that *"action of course is ceaseless, and essential both to the continuation and further elaboration of the system, but subsequent interaction will be different from earlier action because conditioned by the structural consequences of that prior action. Hence the morphogenetic perspective is not only dualistic but sequential, dealing in endless cycles of structural conditioning/social interaction/structural elaboration,*

thus unravelling the dialectical interplay between structure and action” (Archer, 1982, p. 458). She went on to say that, from the morphogenetic perspective, the duality of structure *“oscillates between the two divergent images it bestrides—between (a) the hyperactivity of agency, whose corollary is the innate volatility of society, and (b) the rigid coherence of structural properties associated, on the contrary, with the essential recursiveness of social life”* (Archer, 1982, p. 459). Arguing for the morphogenetic approach, which addresses the failure of structuration to specify times of ‘more determinism’ or ‘more voluntarism’, Archer stated that such an approach deals with these issues by analysing the stringency of constraints and the level of freedom found in different structural contexts for different social actors (Archer, 1990).

Craib (2011) argued that the structure vs. agency divide is prevalent in sociology for good reason and that, as the two are not the same, they should therefore not be seen as mutually constitutive. He further argued that, when analysing other theories, Giddens glossed over complexities and did not fully grasp them. Craib also accused Giddens of attempting to develop an all-encompassing theory of the social world, which he did not deem possible given the many different and incompatible phenomena that make up the world; Craib made reference to Feyerabend’s notion of theoretical pluralism and accused Giddens of developing a theoretical combination in which all ‘differences’ seem to disappear. He further argued that Giddens’s theoretical combination failed to capture or relate to an increasingly unstable, confused, and disjointed world.

Despite this criticism, Outhwaite (1990) expressed some reservations regarding Archer’s morphogenetic approach, mainly about it drawing too sharp a distinction between structure and agency. Outhwaite argued that one of the strengths of structuration theory is that it does not provide for distinct differences between structure and agency. In another response to a criticism levelled by Archer at the duality of structure and at its inability to acknowledge temporality, Outhwaite argued that, whereas it is certainly the case that past structures constrain future action, it is unclear how the duality of structure prevents one from understanding these delayed structural effects. He also took issue with Archer’s criticism of Giddens’s blurring of the distinction between determined and responsible action, as Giddens stated that to act confers, in the first place, the ability to act otherwise.

In another defence of Giddens's work, Stones (2005) also argued that Archer's criticisms were misplaced as Giddens did recognise that the objective context may hinder the actions taken by social agents. In arguing against the criticism of structures being virtual and in memory traces, Stones (2005) stated that structuration also involves objective external structures, but social action is always mediated by virtual internal structures.

In essence, despite the criticism levelled at the duality of structure, the latter successfully captures the reconstitution of society, which, at the time at which structuration theory was being developed, had not been accurately captured by other sociologists and schools of thought (Tucker, 1998).

The following sub-sections break down the duality of structure; beginning with Giddens's understanding of agency and following up with his understanding of structure, as this is how Giddens laid out his argument in his *magnum opus* on grand social theory, *'The Constitution of Society – Outline of the Theory of Structuration'*.

3.1.2 Agency and Dialectic of Control

Giddens's view of agency is made clearer through the understanding of the two main rules that guided the early stages of structuration theory. The first being that sociology is concerned with a 'pre-given' universe that is constituted by the active doings of social agents, and the second being that the production and reproduction of society has to be treated as a skilled performance by social agents (Giddens, 1976, p. 160). These two rules emphasise how Giddens's thinking is more agency-centric compared to those schools of thought that assume action to be determined by or to be a product of a system. Agency does not refer to the intentions of social agents, but rather to their capabilities of doing things.

Agency solely depends on the ability that social agents possess and maintain to 'make a difference' in the production of social outcomes, regardless of whether those outcomes are intended or unintended (Giddens, 1979, 1984, 1990). Because of the notion of social agents possessing the ability to make a difference or influence social outcomes, agency is associated with transformative capacity (Cohen, 1989). This views social agents as being autonomous; *"the seed of change is there in every act which contributes towards the reproduction of any 'ordered' form of social life"* (Giddens, 1993, p. 108).

Structuration theory views human agency as being strongly voluntaristic, with social agents always possessing the ability to act otherwise; Giddens termed this the dialectic of control, where *“all forms of dependence offer some resources whereby those who are subordinate can influence the activities of their superiors”* (Giddens, 1984, p. 16).

Giddens argued the dialectic of control to be a very important aspect of structuration theory. He wrote that the dialectic of control refers to the capability of the weak to turn against the powerful in the regularised autonomy and dependence relationships that constitute social systems or societies. Regardless of how asymmetrically resources are spread, power-based relations of autonomy and dependence operate in both directions, highlighting their reciprocity. Giddens argued that the inseparability of action and power can be handled effectively through the dialectic of control. The dialectic of control is inherent in all social systems and cannot be separated from them, just as action cannot be separated from power. Giddens argued this to the extent to which every social agent within a social system participates in the dialectic of control, even if only nominally. If social agents do not participate in the dialectic of control, they cease to be agents. Only in the extreme case in which a social agent was to be completely controlled and confined, would they not participate in the dialectic of control and therefore cease to be an agent (Giddens, 1984).

Giddens provided an example to highlight this; if social agent *B* were to drug social agent *A*, resulting in *A* becoming completely unconscious and immobilised, the situation would fall outside the scope of the agency and power relation. As *B* would potentially have power over *A*'s fate by having complete control of *A*'s body, it would seem that *B* had complete and absolute power over *A*. This would not be the case; Giddens argued that, by completely immobilising *A*, *B* had foregone any opportunity to benefit from the goods or services of *A* that a continuing social relationship may have provided. Whilst the previous example crosses the boundary or margin of the agency and power relationship, Giddens provided another one, involving a social agent imprisoned in solitary confinement, which does not. This is because, even though this may not seem to be the case, the imprisoned social agent would possess the ability to make a difference. The ability to make a difference can be exercised through, for instance, protest actions such as hunger strikes. The imprisoned social agent would also possess the ability to occupy his or her mind with whatever he or she wished, unlike social

agent A in the first example, who had been drugged and rendered completely unconscious (Giddens, 1982, p. 198).

Although certain power relations may be completely imbalanced, Giddens argued that, even in the most imbalanced of relations, social agents always have some degree of control or ability over conditions of reproduction, and that there is therefore always a dialectic of control that can potentially alter or shift the overall distribution of power, implying that power is never absolute. It is Giddens's understanding that power can be productive as well as repressive, that leads to the dialectic of control, where all forms of dependency offer resources to influence (Giddens, 1984; Tucker, 1998).

Power is the capacity by which social agents can transform or change the world in which they operate through the dialectic of control. The extent to which they can bring about change or transformation depends upon the resources available to them, but, as mentioned above, social agents can always do something, even when in solitary confinement. Social agents would be prevented from doing anything only if drugged and immobilised; however, at that point, they would cease to be agents. Therefore, the dialectic of control refers to the imbalanced degrees of autonomy or sovereignty and dependence that constitute power relations in social systems (Cohen, 1989).

Furthermore, Giddens differentiated between domination and power; domination refers to structured asymmetries of resources within interactions, while, as mentioned, power refers to reproduced relations of autonomy and dependence that take place in interaction. Importantly, Giddens believed that the changes that have taken place in communication technologies have altered power relations (Kilminster, 1991; Tucker, 1998).

To elaborate on power while avoiding criticism pertaining to the broadness of the conceptualisation of power, structuration theory proposes a relational definition of power. Relational power can be defined as *"the capability of actors to secure outcomes where the realisation of these outcomes depends upon the doings of others"* (Giddens, 1976, p. 111). When social agents exercise relational power with intent, they are aware that other social agents will respond in determinate or prescribed manners, and therefore they use this knowledge to bring about the desired responses. Cohen (1989) stated that relational power cannot be understood without acknowledging the role played by the dialectic of control in all

power relations. Cohen further stated that a crucial insight that anticipates the dialectic of control is that, when producing and reproducing, all social systems involve an asymmetrical distribution of resources, which means that, to some extent, all social systems are characterised by political inequality. This is why the dialectic of control is always present for all social agents. As power plays an important role in structuration theory, as it prefigures the dialectic of control, the relative degree of autonomy and dependence within a social system may vary significantly. It should be noted that, through the dialectic of control, Giddens was able to forego the need to choose a side in relation to conceptions of power and to the debate between the individualist and collectivist stances. Whereas the individualist conception of power argues that social agents have a wide range of possible actions and the collectivist one argues that domination is imposed upon social agents, Giddens's notion argues against the latter through structures of domination that may limit certain actions, and against the former by stating that any asymmetrical distributions of resources may always be challenged through the duality of structure, as power is only 'stable for now'.

Therefore, it should not be assumed that, as suggested by some structuralist schools of thought, even the strongest structures of domination produce 'docile bodies' who behave in a prescribed or automatic manner. Emphasising the transformative power of human agency, Giddens further stated that *"to be able to 'act otherwise' means being able to intervene in the world, or to refrain from such intervention, with the effect of influencing a specific process or state of affairs. This presumes that to be an agent is to be able to deploy... a range of causal powers, including that of influencing those deployed by others. Action depends upon the capability of the individual to 'make a difference' to a pre-existing state of affairs or course of events"* (Giddens, 1984, pp. 14-15). He further stated that *"an agent ceases to be such if he or she loses the capability to 'make a difference', that is, to exercise some sort of power... Expressing these observations in another way, we can say that action logically involves power in the sense of transformative capacity"* (Giddens, 1984, pp. 14-15)

3.1.3 Knowledgeability and Reflexivity

Furthermore, understanding the knowledgeability and reflexivity of social agents is also key to understanding Giddens's concept of human agency.

As mentioned, one of the conceptual pillars of structuration theory emphasises that the production and reproduction of society has to be treated as a skilled performance by social agents. This implies that social agents are knowledgeable and aware of the social world around them, being not only active participants but also key composers of the social world. This is in contrast to the structuralist school of thought, whereby many sociologists regard social agents as being the product of the system in which they are. In other words, according to Giddens, social agents are not 'cultural dopes' (a term developed by Garfinkel), because the workings of society are known by knowledgeable social agents by virtue of their being part of the social world (Giddens, 1979, 1982, 1984).

Giddens highlighted the reflexivity of social agents, which goes beyond the understanding of social agents as only being self-conscious, to their being able to actively monitor ongoing social life. This reflexive monitoring of action takes place when social agents attend to the ongoing flow of everyday social life. To clarify reflexivity and its relation to social practices, Giddens stated that *"it is the specifically reflexive form of the knowledgeability of human agents that is most deeply involved in the recursive ordering of social practices. Continuity of practices presumes reflexivity, but reflexivity in turn is possible only because of the continuity of practices that makes them distinctively 'the same' across space and time"* (Giddens, 1984, p. 3). The reflexive monitoring of conduct mainly occurs in a continuous manner rather than in selective moments (Giddens, 1984).

The rationalisation of action is a process by which social agents preserve a tacit understanding of their actions and of what those actions can accomplish in everyday life; this does not imply that social agents are always aware, either discursively or tacitly, of the consequences of their actions. The fact that social agents are knowledgeable and reflexive, and actively produce, reproduce, and transform the world in which they live, does not imply that they are always in control either of their actions or of the outcomes of their actions. This is where Giddens introduced the concept of unintended consequences. To clarify what he meant by 'unintentional', he first wrote about the intentional act, which is an act that a social agent undertakes in the knowledge or belief that it will have a particular outcome or quality and uses that knowledge itself to achieve the particular outcome or quality. Agency refers to doing; as 'doing' and 'intending' can be two different things, they have to be separated. This was clarified by Giddens by means of the example of an individual switching on the light in his

or her house, which alerts a thief standing outside. The switching on of the light and the alerting of the thief outside were both things that the individual 'did'. If the individual in the house was unaware of the thief outside, he or she did not 'intend' to alert the thief; or, if the individual, for some reason, had knowledge of the thief being outside, he or she did not 'intend' to use such knowledge to alert the thief. Giddens further stated that all the outcomes that could follow for the thief, such as being arrested, tried and sentenced to a jail term, would be 'unintended' consequences (Giddens, 1984, p. 10). Unintended consequences recursively lead to unacknowledged conditions of action; the link between unintended consequences and unacknowledged conditions is due to the duality of structure, as previously mentioned. When social agents act in reproducing any structural properties of institutionalised conduct, they could be doing so intending to do so (Cohen, 1990; Giddens, 1976, 1979, 1984).

This view of agency has been criticised by some as being too radical. Critics such as Outhwaite (1990) and Layder (1985) argued that there may be instances in which social agents only have a single option and therefore do not have the ability to act alternatively. Layder (1985) further argued that structural power transcends and precedes social action, and therefore cannot be simplified to the negotiable outcome of social interactions and routines. Giddens counteracted by saying that to presume human agency to be any different from his conceptualisation would be a deterministic position, and that, even when confronted with the extremity of death, social agents still possess agency because of their desire to stay alive. He further responded to the criticism of having over-radicalised agency by stating that this was not the case, as structuration theory emphasises the subtle nature of social or structural constraints. An emphasis, he argued, that should not be misunderstood, as there may be instances in which social or structural constraints are strong; the point he was making was that all constraints are mediated by the social agent through reasoning. Structural or social constraints cannot be construed as a blunt force of nature that impacts a single action, he further argued, which emphasises the subtlety of structural constraints (Giddens, 1984; Jones and Karsten, 2008).

Moreover, Dallmayr (1982) argued that Giddens's concept of agency and his linking it to the process of structuration is ambiguous. Whereas Giddens stated that agency is not the 'intention' to act but rather the 'capability' to do so, Dallmayr stated that this was a 'half-

hearted' conceptualisation, as Giddens had ignored the nexus of action and non-action within agency itself. Social theory should not only consider the 'doing' aspect, but should also take the 'suffering', as an experience endured by social agents, into account. This, Dallmayr argued, cannot be understood through concepts proposed by structuration theory such as unacknowledged conditions, because these conditions are not beyond the boundaries of the knowledgeability of social agents. Giddens responded to this criticism by stating that he agreed that 'structure' does not only participate in the 'doing', where 'doing' is the centrality of 'being', but also in the composition of subjectivity that enunciates the 'being' of human beings. He also responded to Dallmayr's criticism of not having given thought to the 'suffering', in the Heideggerian sense of the word; Giddens stated that structuration theory has a direct connection with the moral frameworks of human existence, but accepted that his work had not explicated this connection in great detail. He further mentioned that, despite being influenced by Heidegger's philosophy, he did not agree with the latter's understanding of human caring. Dallmayr responded to this by saying that it was 'careless of Giddens' (Dallmayr, 1982; Giddens, 1982).

In essence, despite the criticism levelled at Giddens's concept of agency, the articulation of social agents as being knowledgeable and reflexive enables an understanding of the impact and change that they can deliver; the implication being that they actively produce, reproduce and transform the world in which they live (Giddens, 1984, 1991; Giddens and Turner, 1988).

3.1.4 Structure

With regard to understanding Giddens's views on structure, it is beneficial to begin with an analogy he articulated. He wrote that structure is like language, in the sense that it is an abstract property of a community of speakers, sustained through the speech of social agents. While language exists outside time and space, speech acts are situated contextually and temporally and always involve dialogue between social agents. Language is sustained through the ongoing production and reproduction of speech acts and is the condition for the achievement of dialogue (Giddens, 1976, pp. 118-119). Giddens defined structure as *"rules and resources, recursively implicated in the reproduction of social systems. Structure exists only as memory traces, the organic basis of human knowledgeability, and as instantiated in action"* (Giddens, 1984, p. 377).

Looking back at the language analogy, social practices are similarly situated contextually and temporally and can only exist in and through human action or 'instantiated in action'. Social structures condition social practices by providing the contextual rules and resources that enable social agents to make sense of their actions and of those of others. Social systems—i.e., societies—exhibit structural properties that are produced, reproduced and transformed through the interaction of social agents; Giddens argued that this is more appropriate than saying that social systems have structures (Giddens, 1979, 1984). As structures are not enacted in a vacuum, they call on structural properties enacted by prior social action, either that of a social agent or of others. Thus, structural properties established by previous social action come to shape social interaction, which then reproduces the structural properties afresh; *“agents also reproduce the conditions that make such actions possible”* (Giddens, 1984, p. 26). It was by arguing this duality that Giddens acknowledged the objective and subjective features of structure; structure does not just develop through subjective, but also through objective social action, because structure provides the conditions for social action to take place. This means that structure provides the means for its sustenance as it and agency recursively constitute each other. He articulated this in simple terms by stating that *“man actively shapes the world he lives in at the same time as it shapes him”* (Giddens, 1982, p. 21). It is this dialectical interplay between objectivity and subjectivity that contributes to this divide, as it eradicates the need to choose a side (Bryant and Jary, 1991; Cohen, 1989; Craib, 2011).

Giddens differentiated between the rules of social life and formulated rules, with the former referring to the generalised techniques or procedures applied during the production or reproduction of social practices, and the latter referring to the rules of bureaucracy or of a game, which are interpretations, rather than the official rules themselves. Rules cannot be conceived without resources, since it is the latter that provide the means by which transformative rules are assimilated into social practices. Rules are implicated in the performance of social practices and can be seen as generalisable aspects of procedures upon which social agents draw in the reproduction of regularities of practice. This process of reproduction serves as the basis upon which to regenerate existing rules as established features; Cohen (1989) argued that Giddens's most significant contribution to the duality of structure is the treatment of institutionalised rules as structural properties of social

collectivities. Rules cannot be understood in purely holistic terms as they are demonstrated only when institutionalised practices are reproduced. Rules of conduct or social life are reproduced a number of times during the routine activities of agents that are part of a collectivity, and are reproduced and recognised by the collectivity for a significant period of time. In this case, rules are identified in collective terms as the trans-situational properties of the collectivity that are involved in the reproduction of institutionalised action (Cohen, 1989, 1990; Giddens, 1976, 1979, 1984).

Since Giddens's understanding of agency involves actions that can change or transform social outcomes, there must be an aspect of everyday social practice that enables this to happen. This is where resources are used to serve the purpose of change or transformation. Resources are defined as *"the media whereby transformative capacity is employed as power in the routine course of social interaction"* (Giddens, 1979, p. 92). In other words, resources are the facilities or bases of power that social agents possess and can use to their advantage to influence or manipulate courses of interaction with others that can, ultimately, transform social outcomes. The manipulation of resources does not occur in discrete practices but, rather, their mobilisation involves normative and semantic aspects of mutual knowledge. Importantly, resources provide the means by which normative and semantic rules are realised. The resources to which Giddens referred are of two types: allocative and authoritative. Allocative resources stem from the control of material products or aspects of the material world and are defined as *"capabilities. . . or, more accurately . . . to forms of transformative capacity . . . generating command over objects, goods or material phenomena"* (Giddens, 1984, p. 33). Authoritative resources are derived from social agent activity coordination and refer to *"types of transformative capacity generating command over persons or actors"* (Giddens, 1984, p. 33).

An important aspect of Giddens's understanding of structure that has attracted criticism is his view that structure is virtual and exists only in memory traces. Giddens argued that materiality has no structure and that structures are only enacted through human interaction; *"to say that structure is a 'virtual order' of transformative relations means that social systems, as reproduced social practices, do not have 'structures' but rather exhibit 'structural properties' and that structure exists, as time-space presence, only in its instantiations in such practices"*

and as memory traces orienting the conduct of knowledgeable human agents” (Giddens, 1984, p. 17).

This understanding of structure and, in particular, the inclusion of rules and resources, has been criticised as being obscure (Layder, 1981; Sewell Jr, 1992; Thompson, 1989). Sewell Jr (1992) argued that the understanding of rules was ambiguous as Giddens had not given any concrete examples of rules that may actually underlie social practices. Thompson (1989) also criticised Giddens’s concept of rules as being too broad, and stated that rules cannot be so easily generalised, as some are more fundamentally important than others. Giddens’s inclusion of resources into the understanding of structure has also been criticised. By stating that structures are virtual and that resources can be human and non-human, Giddens came under criticism by Sewell Jr (1992), who argued against this, asserting that considering resources to be virtual is dubious. Non-human resources would include, for example, the factories owned by capitalists, the weapons owned by armies, and the land owned by farmers; to assume that these material resources can be considered virtual is questionable, considering that they exist in space and time. Material resources have played explicitly important roles in shaping social outcomes; e.g., armies have been known to win battles purely based on the capabilities of their weapons, whilst certain farmers have prospered purely due to the fertility of their land. Furthermore, to consider human resources such as religious leaders, who have the ability to rally and motivate thousands for their cause, as virtual is also questionable, as they possess observable characteristics that are actualised in the minds of their followers (Sewell Jr, 1992, pp. 10-11). Sewell Jr (1992) argued that including resources into the definition of structure is contradictory and should not be done.

Whilst crediting Giddens with a ‘novel correlation’ of structure and agency and a perspective that has many advantages over the competing systematic and functionalist frameworks, Dallmayr (1982) argued that Giddens’s notion of structure and structuration is somewhat ambivalent and irresolute. He argued that Giddens’s approach seemed reluctant to fully draw the implications of the very notions he proposed.

Giddens understanding of virtual order is indebted in part to Jacques Derrida’s idea of the ‘structuring of structure’. Derrida’s notion involves an ontological difference by which structuration inserts into social analysis a transcendental or non-positive dimension as well

as a factual differentiation of elements. Despite taking this understanding of Derrida into the development of his own ideas, Giddens's notion of virtual order was labelled by Dallmayr as being 'half-hearted'. Dallmayr argued that, in some passages of structuration theory, it can be assumed that virtual order is nothing more than the gathering of those present and absent factors that tend to gradually merge structure with system. Dallmayr further argued that the virtual order of structural properties tends to resemble the structuralist Merton's distinction between latent and manifest functions. The translation of the latent into the manifest is predominantly evident in Giddens's understanding of resources, but less so in the case of rules. The idea that rules can be both the medium and the outcome is somewhat unclear and Dallmayr argued that Giddens's account of how rules are part of the wider process of structuration should have been further strengthened and elaborated upon. Despite this criticism, Dallmayr did state that the inclusion of rules and resources as structural properties had been good and a progressive step. Giddens somewhat responded to the criticism of structure levelled by Dallmayr by stating that he disagreed with Derrida's understanding of the deconstruction of metaphysics, hence his limited exploration of the latter's viewpoints, despite their contribution to his own thinking.

Perhaps the most damning criticism expressed by Dallmayr (1982) was to the very objective that Giddens's structuration theory intended to achieve; to transcend the structure vs. agency dichotomy. Dallmayr argued that Giddens had not succeeded in transcending this dichotomy because of his understanding of actors as being constituted by forces external to them, which implies the influence of structure; this is where Giddens slips into a dualist understanding of structure and agency, rather than a duality.

Further criticisms centred on the lack of empirical evidence provided to substantiate and solidify the concepts. Stinchcombe (1990) wrote that, despite Giddens's promising criticism of Goffman and Garfinkel in setting the scene for structuration theory, the lack of empirical solidity to substantiate concepts had hindered it.

Clark (1990) identified three issues as the focus of the main criticisms to Giddens's work, one of which was the lack of empirical research to solidify the concepts. The other two issues were: the lack of quantitative data and techniques of social research, be they primary or secondary; and the lack of systematic cross reference between empirical research and

theoretical debate. This criticism was levelled despite the fact that Giddens himself had mentioned that structuration theory is to be used as a sensitising device and that it does not wave a 'methodological scalpel'.

The lack of empirical solidity can be viewed in one of two ways. Firstly, as an issue; in that the lack of empirical example offers no guidance on how to proceed when applying the theory. Secondly, as an opportunity; by which the researcher can be creative in the application of the theoretical concepts. Despite the lack of empirical solidity highlighted by authors including Stinchcombe, Cohen (1990) defended Giddens's lack of empirical solidity. By highlighting some of Giddens's theoretical concepts, Cohen stated that "*structuration theory provides conceptual resources well suited to the formulation of empirically defined problems and themes, and to the interpretation of the results of empirical research*" (Cohen, 1990, p. 59).

In essence, despite the criticism levelled at it, Giddens's concept of structure, and the theory as a whole, nevertheless enables an understanding of structure as being both constraining and enabling, with rules playing the constraining role and resources the enabling one. Arguing for structure to be considered virtual, and, to some extent, clarifying the criticism levelled by the likes of Sewell Jr (1992), Giddens accepted and acknowledged the existence of the material world. He argued that, whilst the material world exists, it is the social agent that gives it meaning and that social structures are enacted by means of interaction with the material—e.g., stone walls do not make a prison; rather, it is the human act of imprisonment that does (Outhwaite, 1990).

3.1.5 The Modalities of Structuration

For analytical purposes, Giddens identified and explained the workings of three dimensions of structure—i.e., signification, domination and legitimation—that emerge from the properties of social action. Giddens stated that the separation of structure along these three dimensions serves purely analytical purposes as they are intricately linked in social systems or societies (Giddens, 1979, 1984). The modalities of structuration are presented in figure 3.

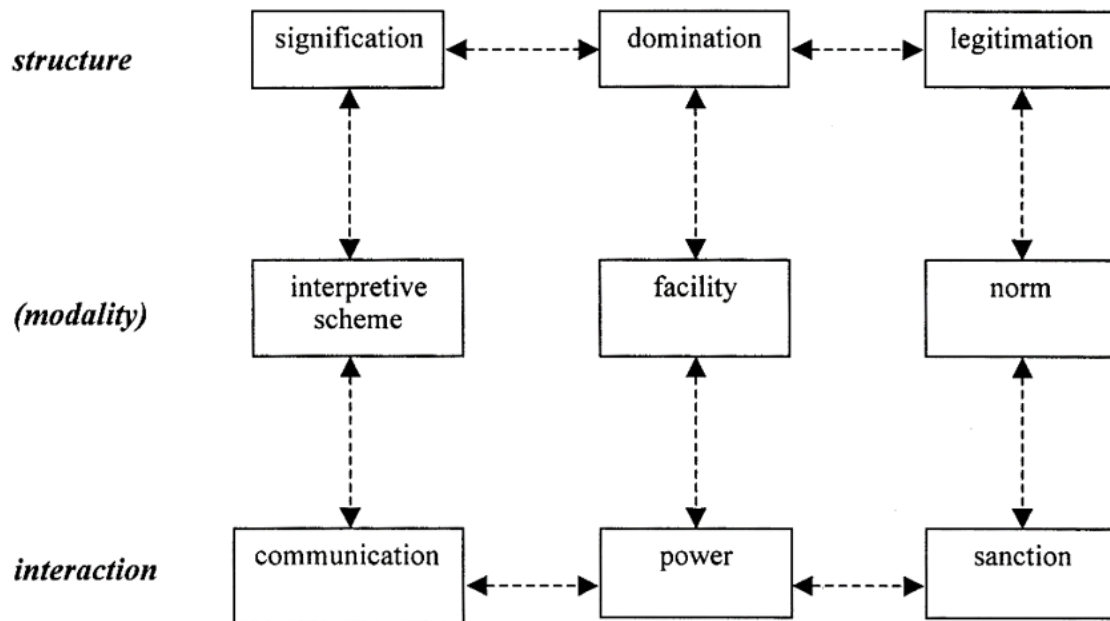


Figure 3 - The duality of structure dimensions model (Giddens, 1984, p. 29)

Signification, domination, and legitimation are the three dimensions of structure, and communication, power, and sanction are the three types of human agency or interaction. Between these, Giddens inserted the modalities of structuration, which are interpretive schemes, facilities, and norms, and are defined as follows. Interpretive schemes are *“standardized, shared stocks of knowledge that humans draw on to interpret behavior and events, hence achieving meaningful interaction”* (Orlikowski and Robey, 1991, p. 148). Facilities are *“the means through which intentions are realized, goals are accomplished, and power is exercised”* (Orlikowski and Robey, 1991, p. 148). Norms are *“the rules governing sanctioned or appropriate conduct, and they define the legitimacy of interaction within a setting’s moral order”* (Orlikowski and Robey, 1991, p. 148).

The modalities of structuration are constituted by the actions of social agents and are enabled or constrained through structural properties. The mediating role played by the modalities of structuration is a crucial element of structuration theory. Looking at the structures in more detail, those of signification are produced through communication and enable social agents to communicate. As structure and agency are mediated by modalities, structures of signification are mediated by interpretive schemes. Through communication, social agents use interpretive schemes or stocks of knowledge to make sense of their actions and of those

of others. This produces or reproduces structures of signification or structures of meaning. When social agents draw upon interpretive schemes or stocks of knowledge in their ongoing interaction with society, these form *“the core of mutual knowledge whereby an accountable universe of meaning is sustained through and in processes of interaction”* (Giddens, 1979, p. 83).

Moving on to structures of domination which are of transformative capacity, social agents use power in their interactions by drawing upon resources, which, as mentioned, can be material or human, to produce or reproduce structures of domination or structures of power. If some social agents possess resources that are needed by others, these can act as sources of power, which enact structures of domination; therefore, these structures are used to influence the conduct of other social agents. Finally, social agents sanction their actions by drawing upon the norms or standards of morality of a social system or society to produce or reproduce structures of legitimation (Craib, 2011; Giddens, 1976, 1979, 1984).

Jones and Karsten (2008) provided an example to clarify what Giddens meant by ‘modalities of structuration’. When social agents go to work in a certain attire, they do so because they are influenced by their workplaces’ social structures and, by conforming to dress codes, they reproduce them. When encountering somebody in the office, social agents draw upon structures of meaning or signification to make sense of the other person’s role. When meeting somebody in a white coat in a hospital, it would be assumed that that person is a doctor. Clothes also transmit information in relation to structures of power or domination, as the social agents’ dress codes can show the powers they hold. For example, a police officer or soldier would command power in certain situations, with other social agents submitting to them based on their attire. Going back to the office example, structures of legitimation would involve sanctions being imposed on those who do not comply with the dress code within the office, as the norms of the latter are not being followed. Again, Giddens’s understanding of agency indicates that these structures can be transformed through social action; however, for as long as the dress code is constantly being followed, the same structures will be reproduced. Should certain individuals challenge the dress code, then the social structures may be transformed. Historical examples show how this has happened in British courts, where judges and lawyers are no longer required to wear wigs, and also in IBM, where employees are no longer required to wear blue suits. This change or transformation of social structures takes

place through what Giddens termed the dialectic of control, by which social agents can always influence and, ultimately, transform social structures (Giddens, 1984; Jones and Karsten, 2008, pp. 129-130).

3.2 Theory of Practice

Bourdieu attempted to overcome the subjective/objective divide by developing the concept of the habitus. Other important aspects of the theory include field and doxa.

Bourdieu defined the habitus as a system of *“durable, transposable dispositions, structured structures predisposed to function as structuring structures, that is as principles of generation and structuring of practices and representations which can be objectively 'regulated' and 'regular' without in any way being the product of obedience to rules”* (Bourdieu, 1977, p. 72).

The idea that society can be viewed as a number of social fields is a fundamental belief of Bourdieu's work. A field can be defined as *“a series of institutions, rules, rituals, conventions, categories, designations, appointments and titles which constitute an objective hierarchy, and which produce and authorise certain discourses and activities”* (Webb et al., 2002, pp. 21-22). Looking at a further definition, Bourdieu, defined a field as *“a network, or configuration, of objective relations between positions. These positions are objectively defined, in their existence and in the determinations they impose upon their occupants, agents or institutions, by their present and potential situation (situs) in the structure of the distribution of species of power (or capital) whose possession commands access to the specific profits that are at stake in the field, as well as by their objective relation to other positions.”* (Bourdieu and Wacquant, 1992, p. 97).

When explaining the competition within fields for capital, Bourdieu, referred to the terms reproduction and transformation. Commonly, agents within a field adjust their subjective expectations of attainable capital according to the position they have within the field or their objective probability of profit. These expectations are formed through different factors such as social class, connections and educational background. It is this subjective expectation or lack of it that can lead to the reproduction of symbolic domination and assist in creating conditions of oppression. Reproduction is the passing of cultural values and norms from generation to generation and Bourdieu stated that the ability that social actors have to impose and engage their cultural productions plays a paramount role in the reproduction of

dominating social structures. Transformation can occur when the capital of an agent changes dramatically and this can be because of a number of reasons such as new found fame etc. Bourdieu stated that all fields can reproduce themselves through four main modes of operation which are; misrecognition, symbolic violence, illuso and universalisation (Bourdieu, 1977; Bourdieu and Wacquant, 1992; Webb et al., 2002).

Misrecognition is described as a form of forgetting by an agent that they are caught up in the world and that they are produced by it. Misrecognition is the function of symbolic violence which can be exercised upon an agent with or without complicity. Symbolic violence can take a number of forms including denial of resources and being treated as inferior. A historic example of this is how females accepted the symbolic violence they were exposed to as 'normal' or 'the way it was meant to be', when being treated as inferior to men. Illusio refers to the unthinking commitment that an agent has to the values of his/her field, whilst universalisation is the attempt to universalise values with the field as a whole. An example of these dynamics in action was demonstrated by Avery Brundage, the fifth president of the International Olympic Committee. Brundage attempted to promote values of 'pure sport' but was actually promoting his political and sectarian upper class values which demonstrated misrecognition. Brundage restricted the Olympics to amateurs that would not get paid as he associated being paid with not upholding the values of 'pure sport', but in reality, athletes were being paid through avenues such as sponsors and governments. Brundage allowed these tacit payments whilst living out an illusio that he was promoting 'pure sport'. Universalisation took place when Brundage attempted to spread the so called 'pure sport' values of the Olympics to all sports within the field. Only those who remained amateur were recognised as promoting 'pure sport' (Bourdieu, 1977; Bourdieu and Wacquant, 1992; Webb et al., 2002).

Agents seek to gain a monopoly over the capital that is available in the field that they are operating in; this again highlights Bourdieu's sociology of conflict. An agent's position within a field is defined and controlled by the level of capital they possess which can as stated be in the form of social, economic or cultural. The different forms of capital are the core factors that affect the position of an agent in a field. Bourdieu stated that the most important field in any society is that of power and politics; this is because the hierarchy of power relationships within the political field serves to structure all other fields (Bourdieu, 1977, 1986).

Doxa is referred to by Bourdieu as *“that which is taken for granted”* within a society (Bourdieu, 1977, p. 166). It is the set of rules or norms that are accepted by a society as to how the world works and every field as its own doxa. The rules or norms are so natural and widely accepted that they are on the most part never even thought about. It is the *“primal set of innocence”* and it comes under *“the unthinkable and the unsayable”* (Bourdieu, 1977, p. 169). It is sustained through everyday acceptance but normally only comes under question during a crisis, where the doxa is challenged. When this crisis takes place, the reconstitution of another doxa is known as heterodoxy (Bourdieu, 1984). An example of changing doxa (heterodoxy) would be the changes that are taking place to the family structure in the UK. Previously, the doxa of marriage was between a man and a woman. With changing laws on same sex civil partnerships and marriages, it has meant that society has had to reconsider the doxa of marriage.

When the habitus and field match, the agent acts instantly. It is like a fish in water without the fish even knowing that it is in the water. When the habitus does not match the field, the individual has to learn the new rules of the field which is like a fish out of water. As individuals move through different fields they add the values and imperatives of the field to their habitus; the relationship between the field and habitus functions to produce the ‘bodily hexis’ (Webb et al., 2002).

Moreover, Bourdieu made strong reference to culture and to how culture impacts the social action taken by social agents (the building up of the habitus); conversely, Giddens did not make much reference to culture per se. This is because, unlike the concept of the habitus, in which the social agent can be seen as a product of social circumstances or conditions, Giddens placed more emphasis upon the routines that are necessary for the reproduction of society, and less upon social circumstances (Bourdieu, 1977, 1984; Bourdieu and Wacquant, 1992; King, 2000; Webb et al., 2002).

The habitus has been criticised for lapsing back into the very objectivism that Bourdieu had attempted to tackle and overcome (King, 2000). Thus, Bourdieu’s concept of the habitus—albeit introduced to liberate the social agent and challenge the structuralist school of thought led, at the time, by scholars such as Levi-Strauss—is not suited to explain or understand social change. The habitus, internalised by social agents, slips back into objectivism because it is

derived from the structural or socioeconomic position in which the social agents find themselves. This is surprising because in his initial writings, Bourdieu emphasised how society is built up through the virtuosic intersubjective social practices of social agents. It was only later, when he introduced the concept of the habitus, that he no longer attributed the origin of social action to the interaction among social agents but to the objective social structures with which they are faced. To clarify this further, according to Bourdieu, social agents unconsciously internalise their social conditions, which can be economic, class, appropriate tastes, etc. Social agents would perform and behave in a manner that would be befitting to their respective habitus, which is built up from their structural conditions.

Bourdieu stated how social agents show an *amor fati*—the love for destiny or fate—by which they automatically fulfil the role set out for them by their objective conditions; i.e., social agents automatically live their life according to their habitus. The following extract highlights how the habitus unconsciously embodies social structure; *“each agent, wittingly or unwittingly, willy nilly, is a producer and reproducer of objective meaning. Because his actions and works are the product of a modus operandi of which he is not the producer and has no conscious mastery, they contain an “objective intention,” as the Scholastics put it, which always outruns his conscious intentions”* (Bourdieu, 1977, p. 79). This is further highlighted in the following extract, which, perhaps more evidently, condemns the concept of habitus to clear objectivism; *“it is because subjects, strictly speaking, do not know what they are doing that what they do has more meaning than they know”* (Bourdieu, 1977, p. 79).

This begs the question of how this understanding of social agents and human agency differs from that proposed by the structuralist school of thought, where social agents are viewed as the products of structure. Bourdieu gave the example of social agents from less privileged and uneducated backgrounds entering the educational arena with a reduced chance of success due to the social structures in which their habitus was formed, a habitus built up of educational underachievement. If a social agent’s social action is the resultant of a habitus built up from structural positions, then the wider implication of this at the societal level is that all social agents are the product of their habitus or, in other words, are reactive to their habitus or enslaved by it. This brings up the idea of cultural dopes and differs from Giddens’s view of human agency being highly autonomous, with social agents always having the ability to act otherwise. The development of the habitus means that society does not consist of

interactions between social agents in the forming of social structures but, rather, that it is the product of a dialectic between structure and practice. By contrast, Giddens (1984) saw social structures as being formed through the agency possessed by social agents in the production and reproduction of social structures; the crucial element of this is that every single act can result in transformation or change, which is difficult to understand through Bourdieu's concept of habitus.

3.3 Actor-Network Theory (ANT)

Actor-Network Theory (ANT), has been acknowledged for its capacity in allowing IS scholars to understand the complexity of social interaction with IT (Callon and Latour, 1981). Applied in many fields, it has been used in IS to study technological implementation, and the social processes associated with it (Hanseth et al., 2004; Walsham, 1997).

Some of the central concepts of ANT include actor, actor-network, translation, problematisation, obligatory passage point, interessement, enrolment, inscription, delegates, betrayal, irreversibility, and black-box. Actor refers to *"any element which bends space around itself, makes other elements dependent upon itself and translates their will into the language of its own"* (Callon and Latour, 1981, p. 286). In other words, an actor can be either human and non-human, such as technological artifacts. Not differentiating between human and non-human actors is a unique feature of ANT, which has received criticism. Scholars have questioned how non-human actors can have interests of their own (Walsham, 1997). Moreover, ANT adopts a relational approach to actors, meaning that each actor is defined and understood in relation to other actors. Actor-network refers to a *"heterogeneous network of aligned interests, including people, organisations and standards"* (Walsham and Sahay, 1999, p. 42). Translation refers to the process where the interests of a diverse set of actors are aligned with the focal actor. Law (1992), argued that there can be no absolute way in which effective translation can be ensured, and that translation strategies are essentially local and contingent on the situation. Problematisation refers to the first moment of translation, at which point a focal actor defines the interests and identities of other actors consistent with its own interests. Moreover, it is the moment where the focal actor renders itself indispensable by establishing themselves as the obligatory passage point. The obligatory passage point refers to a situation in which all actors are able to achieve their interests, as defined by the focal factor. Interessement refers to the second moment of translation, which

involves actors negotiating, to accept definition of the focal actor. If interessement is successful then enrolment takes place, which is the third moment of translation and where other actors in the network accept and become aligned to the interests defined by the focal actor. Enrolment is essentially where a body of allies, both human and non-human, is created, and their interests are translated to align with the actor-network. Inscription is where certain interests are protected through the creation of artifacts. Delegates are actors that 'stand in and speak for' other actors. Betrayal refers to a situation where actors do not abide by the agreements arising from the enrolment of their representatives (Callon, 1986; Walsham, 1997). Irreversibility refers to *"the degree to which it is subsequently impossible to go back to a point where alternative possibilities exist"*, and black-box refers to *"a frozen network element, often with properties of irreversibility"* (Walsham and Sahay, 1999, p. 42).

IS scholars have made use of ANT within the discipline to a number of effects—e.g. Monteiro and Hanseth (1996) explored translation and inscription in regard to information infrastructures. Walsham and Sahay (1999) made use of ANT to detail the mutual dependency between the social context and technological properties in the implementation of GIS systems by Western developers in an Eastern location. Hanseth and Braa (1998) used ANT to explore the evolution of an information infrastructure. In another study, Hanseth and Monteiro (1997) further used the concepts of translation and inscription to explore information infrastructure development.

Despite the benefits that may be provided by ANT, the theory has received considerable criticism. Walsham (1997) has criticised ANT for its descriptive power as opposed to its power to explain, its neglect for social structures, its balanced view of humans and non-humans, and its neglect of political and moral analysis. Moreover, Walsham (1997) detailed the difficulty of managing large amounts of data when using ANT. ANT has also been criticised for ignoring macro-social structures, focussing largely on the micro-level. Despite ANT advocates arguing that both levels can be explored through the theory, Walsham (1997) recommended drawing upon structuration theory to overcome this problem with ANT.

The major difference between ANT and structuration theory is in regard to their respective positions on technology; structuration theory makes no explicit reference to technology, while ANT refers to technology as an independent actor by itself. This having been said, ANT

provides an asymmetrical perspective of structure and agency, as it focuses largely on the agency aspect, not accounting for pre-existing structures (Whittle and Spicer, 2008). In comparison, structuration theory through its symmetrical perspective on structure and agency provides more of an apt articulation on both, which is important for this study considering the state of the crowdsourcing literature.

3.4 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) was developed as a way to explain why users accept or reject IT (Davis, 1989; Davis et al., 1989). TAM provides the basis through which it can be traced how external variables influence attitude, belief and intention to use, in regard to IT. Two cognitive beliefs are postulated by TAM—namely, perceived usefulness and perceived ease of use. Perceived usefulness is defined as *“the degree to which a person believes that using a particular system would enhance his or her job performance”*, and perceived ease of use is defined as *“the degree to which a person believes that using a particular system would be free of effort”* (Davis, 1989, p. 320). In essence, the model argues that attitude, behavioural intentions, the perceived usefulness of the system, and the perceived ease of use of the system influences directly or indirectly, one’s actual use of the system. Furthermore, the model proposes that external factors could affect the intention and actual use of the system through mediated effects on the perceived usefulness of the system, and the perceived ease of use of the system. Figure 4 depicts the traditional TAM model.

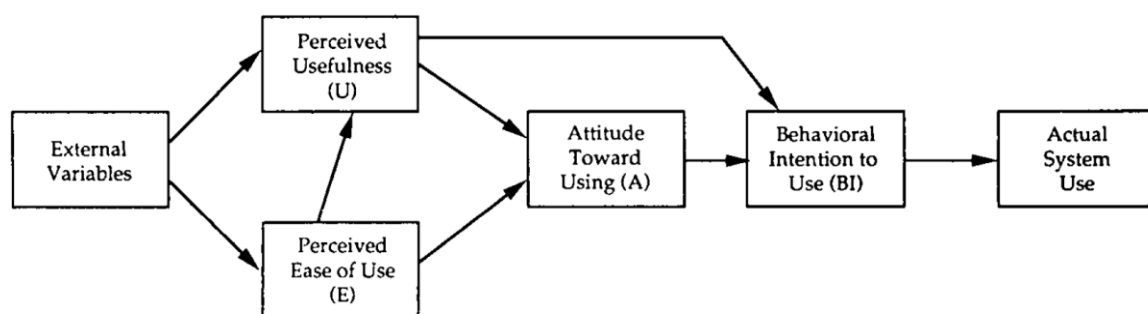


Figure 4 - TAM Model (Davis et al., 1989, p. 985)

The model has also evolved over time and been extended by other scholars. For example, TAM 2 extended the original to account for usage intentions and perceived usefulness, such as experience, cognitive instrumental processes (job relevance, output quality, and result demonstrability) and social influence (subjective norm, voluntariness, and image) (Venkatesh

and Davis, 2000). Moreover, TAM 3 was introduced to account for perceived risk and trust (Venkatesh and Bala, 2008). Looking at further studies, Agarwal and Prasad (1998) added the construct of compatibility to TAM, J. W. Moon and Kim (2001) added the construct of playfulness to TAM, and Chau (1996) added to perceived usefulness through the ideas of near and long-term.

Despite the usefulness of TAM in understanding why users accept or reject IT, the model has received considerable criticism by scholars. This typically centres on scholars detailing empirical inconsistencies in regard to the major constructs proposed by TAM. Looking at this criticism, Jackson et al. (1997) argued against a relationship between usefulness and attitude. Furthermore, the authors argued against an empirical relationship between perceived usefulness and behaviour intention; *“the finding of a nonsignificant relationship between perceived usefulness and behavioral intention is surprising”* (Jackson et al., 1997, p. 379). Moreover, Lucas and Spitler (1999) found no relationship between perceived usefulness and actual use of information systems.

Other scholars have expressed the lack of empirical evidence to support a relationship between perceived ease of use and perceived usefulness. For example, Chau and Hu (2001) argued that *“contrary to the assertion of TAM and the findings reported by some prior research (e.g., Venkatesh, 1999), perceived ease of use was not found to have any significant effects on perceived usefulness or attitude”* (Chau and Hu, 2001, p. 712). Furthermore, Chau (1996) found no relationship between perceived ease of use and behaviour intention. The author goes on to say that *“there is no significant, direct relationship between perceived ease of use of the technology and intention to use. In other words, whether or not the technology is easy to use influences the user’s intention to use only indirectly via the perception of near-term usefulness. This finding concurs with that of the original TAM but contradicts the results obtained in many previous studies... where ease of use was a significant determinant of intention to use a computer technology”* (Chau, 1996, p. 197).

In essence, TAM has received considerable criticism in the literature. Benbasat and Barki (2007) argued that the several evolvments and extensions of TAM have caused considerable confusion and chaos, amongst the research community. Moreover, and rather importantly, TAM is essentially a positivist theory, based on the variance logic. This means that it does not

account for the how and why aspects of change, therefore, not providing a suitable lens to explore the objectives of this study.

3.5 Punctuated Socio-Technical Information System Change (PSIC) Model

The Punctuated Socio-Technical Information System Change (PSIC) model, an evolution and extension of the process model, was elucidated by Lyytinen and Newman (2008) as a sensitising device to explain IS change, as multi-level, punctuated, and socio-technical. The model addresses three issues related to IS change; the scope of IS change and the organisation and properties of systems involved in this change, the nature of the change in systems related with IS change, and the content and ‘engine’ of such change as a socio-technical phenomenon (Lyytinen, 2004; Lyytinen et al., 1998). The PSIC model integrates three theoretical streams into one theoretical model of IS change; process theory, socio-technical system theory, and theory related to punctuated equilibrium and multi-level systems (episodic system change). Figure 5 depicts the PSIC model.

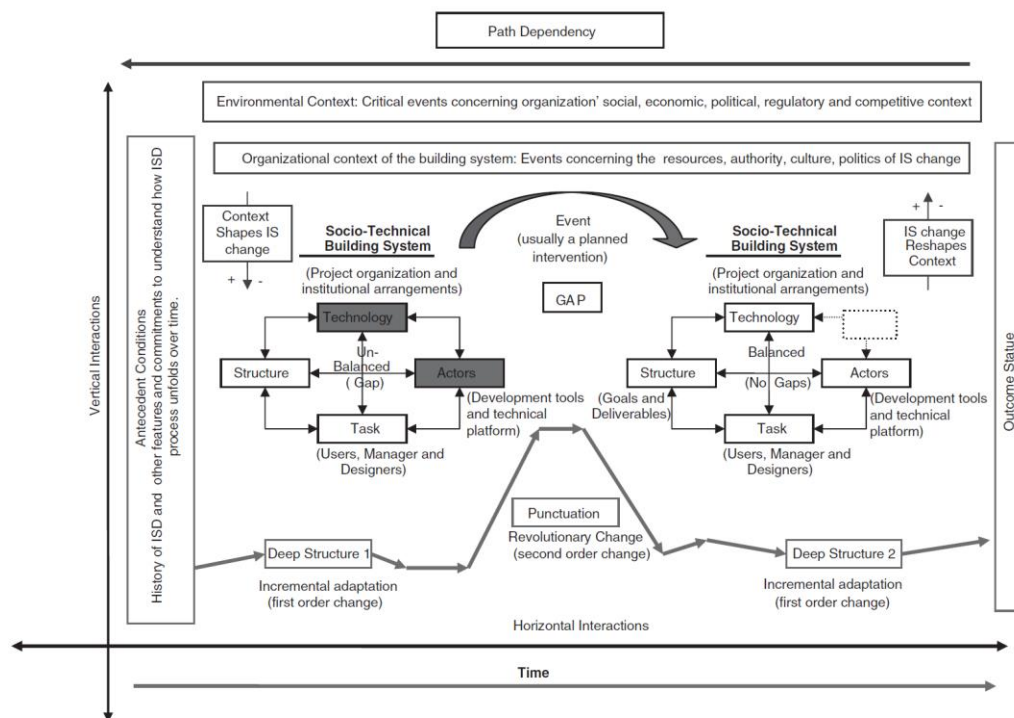


Figure 5 - PSIC Model (Lyytinen and Newman, 2008, p. 600)

The model makes use of concepts such as events, gaps, event sequences, components, interventions, system levels, and punctuations. The three aforementioned issues related to IS change—namely, scope, nature, and content, are elaborated upon as follows—*The scope*

of IS change: The PSIC model portrays change as being multi-level. These levels, known as socio-technical systems, include the work system, the building system, and the organisational environment. The authors developed this aspect after criticising existing IS change models as prescriptive or descriptive, that only explain change on one level, therefore, neglecting the interactions that take place between multiple systems and the organisational environment. *The nature of IS change:* As the PSIC model is based on theories of episodic change by Gersick (1991), the nature of IS change is viewed as consisting of episodes of revolutionary punctuations, or system disorder, followed by phases of stability. Alterations are considered to be slow moving. *The content of change:* The PSIC model views the content of change as punctuated socio-technical change. As it is based on the socio-technical model by Leavitt (1964) to describe the content and 'engine' of change, it views organisations as possessing four components that interact with each other—namely, actor, task, structure and technology.

Essentially, the PSIC model depicts IS change as a sequence of changes (which can on occasion be punctuated) ordered through a hierarchy of diachronic events. It acts a sensemaking tool, allowing for the comprehension of the different events that take place related to IS change. In essence, the proposed model depicts IS change as a *“subtle interplay between technologies, actors, organizational relationships, and tasks at multiple levels. The change can be either incremental or punctuated and it is co-evolutionary in that it distinguishes multiple separate, but interacting streams of events – the work system, the building system, and the organizational environment. Any of these sociotechnical systems has the potential to inject gaps that will trigger interventions into the focal systems leading occasionally to punctuations”* (Lyytinen and Newman, 2008, p. 609).

The PSIC model has been applied by scholars in a number of empirical settings—e.g. Newman and Zhu (2007) explored a specific Information System Development (ISD) project. Amongst the interesting findings using the model, the authors detailed that the project implementation context, consisting of the organisational and external environmental context, played a significant role in the project implementation process. Also, the authors explicated that the project team played a vital role in ensuring the stability of the project and dealing with unexpected events. Newman and Zhao (2008), explored the process of Enterprise Resource Planning (ERP) implementation in two Chinese enterprises, and the decisions concerning

business process reengineering. Amongst the important findings of the study, the authors detailed the vital role of the project team in safeguarding the stability of the project and responding to unexpected events. The authors also elaborated on the limited importance of cultural issues. Newman and Zhu (2009) also explored a specific ISD project. The authors explored the UK retail context, and explicated similar findings to the aforementioned studies—namely, the vital role of project teams in dealing with unexpected events.

Despite the usefulness of the PSIC model in explaining IS change, the model itself is relatively new and has not been applied in many different contexts; therefore, there is a limited understanding of how useful the model is in wider contexts. Moreover, the model is descriptive and requires a theory of explanation to be adopted in conjunction with it. Also, Ahmad et al. (2011) have argued for the improvement of the model in terms of its methodological aspects; this concern has also been expressed by Lyytinen and Newman (2008).

3.6 The Selection of Structuration Theory

This section explains and justifies the adoption of structuration theory by this study. As explained in the methodology chapter (section 4.5), this research adopts an abductive research logic approach (Agar, 2010; Alvesson and Skoldberg, 2009; Fine, 2004; Klag and Langley, 2013; Locke et al., 2008; Whetten, 1989).

Based on this approach, during data collection, when initial themes emerged, they were compared with different theoretical approaches. Themes such as enhancing credibility, the role of the crowd, crowd conflicts, control, gaining legitimacy, crowdmapping challenges, crowdmapping management, crowd ambiguity, crowd eagerness-to-know, crowd monitoring-of-results, and crowd interest-in-results, resonated well with structuration theory. Accordingly, the theory was re-read in-depth and its application in IS was significantly reviewed. The themes that emerged from the data resonated with the following concepts from structuration theory, as detailed in table 5.

Table 5 - The main concepts from structuration theory applied in this study, (Giddens, 1984)

Concept	Definition
Duality of Structure	“Structure as the medium and outcome of the conduct it recursively organizes; the structural properties of social systems do not exist outside of action but are chronically implicated in its production and reproduction” (Giddens, 1984, p. 374).
Knowledgeability	“Everything which actors know (believe) about the circumstances of their action and that of others, drawn upon in the production and reproduction of that action, including tacit as well as discursively available knowledge” (Giddens, 1984, p. 375).
Reflexive Monitoring of Action (Reflexivity)	“The purposive, or intentional, character of human behaviour, considered within the flow of activity of the agent; action is not a string of discrete acts, involving an aggregate of intentions, but a continuous process” (Giddens, 1984, p. 376).
Dialectic of Control	“The two-way character of the distributive aspect of power (power as control); how the less powerful manage resources in such a way as to exert control over the more powerful in established power relationships” (Giddens, 1984, p. 374).
Relational Power	“The capability of actors to secure outcomes where the realisation of these outcomes depends upon the doings of others” (Giddens, 1976, p. 111).
Rationalisation of Action	“The capability competent actors have of 'keeping in touch' with the grounds of what they do, as they do it, such that if asked by others, they can supply reasons for their activities” (Giddens, 1984, p. 376).
Structure	“Rules and resources, recursively implicated in the reproduction of social systems. Structure exists only as memory traces, the organic basis of human knowledgeability. and as instantiated in action” (Giddens, 1984, p. 377).
Allocative Resources	“Material resources involved in the generation of power, including the natural environment and physical artifacts; allocative resources derive from human dominion over nature” (Giddens, 1984, p. 373).

It should be noted that structuration theory does not represent itself as a grand theory that can be systematically incorporated into an empirical investigation; rather, it is a way of thinking or a ‘sensitising device’ pertaining to the social world and to the understanding of society and the social order, and of how social change takes place (Cohen, 1989; Giddens, 1984; Klein and Myers, 1999). This having been said, despite Giddens writing that structuration theory should be used as a ‘sensitising device’, Turner (1986) argued that the

theory offers too many detailed and comprehensive insights into the dynamics and properties of social action and interaction for it to be considered a mere 'sensitising device'.

The following section presents a review of the different approaches to applying structuration theory in IS.

3.7 The Application of Structuration Theory in IS

This sub-section looks at the specific application of structuration theory in IS. Poole and DeSanctis (2004) described structuration theory as "*one of the most influential theoretical paradigms influencing IS research*" (Poole and DeSanctis, 2004, p. 207).

The IS discipline has made use of structuration theory in three main ways. A first set of literature applies structural concepts such as the duality of structure, the dialectic of control, unintended consequences, etc. Two further sets of literature are based on adaptations of the theory—namely, Adaptive Structuration Theory (AST), developed by DeSanctis and Poole (1994), and the duality of technology, developed by Orlikowski (2000). These three sets of literature are now examined.

3.7.1 The Application of Structural Concepts

A significant amount of IS research has applied structuration theory in its more original sense, mainly through its concepts of the duality of structure (analytically, through the modalities of structuration model), the dialectic of control, unintended consequences, etc. The most influential studies to have used structuration theory in this manner are now explored.

Walsham and Han (1993) highlighted the processes of strategy formation and implementation of three computer-based IS, the purpose of which was to monitor and control development projects. The authors based their study on the duality of structure, which was demonstrated through the modalities of structuration model, and explained its aspects; how structures of signification, domination and legitimation are reinforced or modified. The study found that structures of domination are continually reproduced, resulting in compromised system effectiveness. Practical and discursive consciousness are also discussed, together with how routinisation relates to practical consciousness. Interestingly for this research, the authors stated that "*the theory was used not only as a method of analysis of the case . . . but also as a sensitising device to guide the field research itself . . . The evidence of this case study*

suggests that structuration theory can provide both a valuable methodological guide for IS field research, and a subtle theoretical basis for subsequent case analysis” (Walsham and Han, 1993, pp. 207-208). The study highlighted the importance of focussing not only upon the technical aspects of IS, but also upon its participatory ones. Also, the importance of understanding IS not just within the organisational context, but also in the wider one, was illustrated.

Karsten (1995) examined the implementation of a software within a consulting firm and the complexities associated with this implementation. The author explored this case during the pre-implementation stage, when the views of the various participants diverged and converged. Through the views of the participants, the author attempted to understand whether ‘new’ technologies are, or not, more effective than a combination of conventional IS. Structuration theory was adopted because of its adept consideration of change; also, the duality of structure was understood by means of the analytical prowess provided by the modalities of structuration. Agency, in terms of knowledgeable and reflexive monitoring of action, was also mentioned as per Giddens’s understanding, and the study highlighted key organisational changes that were brought about by the introduction of the software. The author made an interesting point in regard to understanding change through structuration, *“change is alteration in the institutional rules and resources, in the structural properties of social systems. Change in social structures occurs via reflexivity, via unexpected consequences of intentional action and via changes outside the social system. The change can be seen – when looking back – as having taken place owing to a critical incident that happened earlier. On the other hand, change can be so subtle and so slowly incubating that it can be noticed only when an incident causes the actors to reflect on it”* (Karsten, 1995, p. 11). The study emphasised the importance, when using structuration theory, of looking for key changes resulting from the usage of technology.

Montealegre (1997) examined the interaction between an IS and the social/organisational setting in which it is embedded, with the inclusion of external social structures; the author stated that his study differed from previous ones because he had looked at the overlapping of social systems (environment), which other authors had failed to do as they had only focused upon internal structures. It was argued that, by not looking at the external social structures, an accurate picture of IS cannot be formed. Three different contexts were

explored—namely, environmental, organisational and IT—during the period in which the technology was being introduced. The duality of structure was used to look at this through the modalities of structuration. The author also mentioned ontological security, as per Giddens’s understanding. The study found that, throughout the IT implementation, structural rules and resources within the environmental, organisational, and IT contexts were produced, reproduced and changed. The way in which meaning was shared, norms and resources were communicated, and social action was sanctioned and facilitated, sustained and changed the social structures during the process of IT implementation. The author reaffirmed Giddens’s understanding of agency; *“Giddens insists on our potential to choose actions deliberately and to carry them through effectively, even in defiance of established rules and prevailing powers – in other words, on the possibility of agency”* (Montealegre, 1997, p. 108). The study highlighted the importance of looking at the bigger picture, by including structures that are on the outside.

In his study, Walsham (2002) explored cross-cultural software production and its use within an insurance company. Structuration theory was used to provide a new way of looking at cross-cultural working and IS. Specifically, the author introduced the concepts of structure, culture, contradiction and conflict, and reflexivity and change. It was argued that IS embody interpretive schemes, provide coordination and control facilities, and encapsulate norms. This implies that IS are deeply implicated in the modalities that exist between agency and structure. IS are drawn upon to provide meaning, exercise power, and legitimise actions, which indicates that they are deeply involved in the duality of structure. Furthermore, the author detailed situations of conflict and contradiction. In essence, the study highlighted the importance of looking out for contradiction and conflict between actors. Furthermore, reflexivity and change were made evident when the social agents thought about their current situation or interactions and what needed to be done to change. Also, the development of an increased recognition of a situation’s importance provided an example of reflexivity.

Lyytinen and Ngwenyama (1992) examined the phenomenon of computer supported cooperative work (CSCW), and used structuration theory to illustrate it and provide a formal definition for it. The concepts that were explored included the duality of structure, agency (knowledgeability, practical and discursive consciousness, rationalisation of action), and structure (rules and resources). The modalities of structuration were also mentioned.

Furthermore, unintended consequences were discussed and a model of structuration theory covering aspects of agency and structure was detailed. Also, system and social integration were explained. In essence, various aspects of structuration theory were used to illustrate the phenomenon of CSCW.

Sahay and Walsham (1997) looked at the relationship between managerial agency and social structure within a broad societal context—namely, a government initiative to use a GIS for the management of degraded land. The authors used structuration theory to understand the impact of the micro on the macro and vice versa; it was argued that, although this aspect is generally troublesome to understand, structuration theory helps to do so. Furthermore, unintended consequences were discussed, as were conflicts and contradictions between actors. Agency was looked at in the context of technology. The aspects of structure that contribute to agency, such as national, communal, religious and intellectual considerations, were explored, as were the aspects of agency that contribute to structure. The study emphasised the importance of highlighting the resources critical in the relevant social systems and who has control over them.

By means of structuration theory, Barley (1986) examined the changes that medical imaging devices such as CT scanners are bringing to the organisational and occupational structure of radiological work. Having broken it down into phases, the author explored structuring at different points: negotiating dependence, constructing and ensuring ineptitude, and moving towards independence. By the use of structuration, the study found that technology can bring about change in roles and patterns of interaction, which, in turn, can trigger change in organisational structures. The study highlighted the importance of understanding the situation both before and after implementation, to comprehend what the technology is enabling.

For in-context IS research, K. Braa and Vidgen (1999) proposed a research framework to be used to position 'purified' and 'hybrid' forms of research methods. In-context IS research is a mix of interpretation, reduction, and intervention. The three 'purified' forms of research are action research, soft case study and field experiment; whilst the three 'hybrid' research methods are hard case study, quasi experiment, and action case. The authors coined the term 'action case', as a hybrid of the methods of action research (intervention) and soft case study

(interpretation). The authors stated that, for their proposed framework, they had partly been inspired by Giddens's understanding of the duality of structure. Furthermore, the authors discussed the importance of unintended consequences for their research context, by stating that; *"this means that any in-context IS research initiative, regardless of the research tradition and methods adopted, will have unintended consequences and a degree of uncertainty concerning how the research project will play itself out"* (K. Braa and Vidgen, 1999, p. 27).

Through continuously refined models of systems development, Elkjaer et al. (1991) investigated the possibility of reaching a stage at which system use would be unproblematic. The authors viewed systems development as something that succumbs to the pressures of those organisations that are striving to survive. Furthermore, they viewed systems development as a paradox between 'proper' systems and the need of system developers to keep their jobs. Power relations were mentioned through structures of domination, but no explicit mention was made of dialectic of control. It was argued that the existence of structures of domination implies that inequality can be reproduced. The intended and unintended effects of systems development were explored. The unintended consequences of routinised action were also looked at, as were the unacknowledged conditions of action which are recursively instantiated through unintended consequences. Although the authors did not explicitly mention the dialectic of control, it was made apparent that the analysis of power relations could benefit from an exploration of the concept.

Orlikowski and Yates (2002) looked at the notion of temporal structuring as a means to understand time as an enacted phenomenon within an organisation. The duality of technology, Orlikowski's own adaptation of the duality of structure, was used (it is explored in the duality of technology, section 3.4.3). Through their agency, social agents enact temporal structures that, in turn, shape their ongoing actions; this, in other words, is the duality of structure. Furthermore, agency was looked at in the same sense as Giddens had, as were knowledgeability and reflexivity.

Sahay (1998) also looked at temporal issues with the addition of space when he examined the implementation of IT and the impact of time and space issues on it; the study focused upon GIS software that had been developed in the West to be implemented in the East. Issues of modernity and globalisation were also looked at. To do this, the author made use of

time/space distancing along with Giddens's ideas on traditional and modern societies (these are not specifically part of structuration theory, as they appear in Giddens's later writings). In essence, the study found that time and space issues do have an impact on the implementation of IT.

Schultze and Orlikowski (2004) sought to understand the role of technology in interfirm relations between customers and sales representative's practices and interpersonal relationships; the application under investigation being self-serve technology. The duality of structure, in its particular duality of technology IS adaptation, was used. Furthermore, the unintended consequences of technology were explored. The study found that self-serve technology causes problems in maintaining embedded relationships between sales reps and customers; in essence, the technology causes a number of issues in interfirm relations. The study emphasised how technology can be constraining, as opposed to enabling.

Dennis and Reinicke (2004) explored electronic brainstorming technology and stated that they had followed Giddens's thinking, in that structures in technology make it easier to adopt certain social structures, but difficult to adopt others. This thinking is actually more in line with the views held by DeSanctis and Poole (1994) who argue for the AST adaptation, as Giddens had articulated that the physical cannot embody structure; (AST is explored in section 3.4.3).

In another study, Orlikowski (2002), sought to better understand organisational knowing in practice—i.e., the role played by human agency in knowing what to do and getting things done in complex organisational tasks. The duality of structure was mentioned as were agency and knowledgeability, as defined by structuration theory. The study found that knowing what to do in terms of complex organisational work is grounded in everyday social actions. It also highlighted the importance of focussing upon everyday practices, which, in essence, is what structuration theory is about.

Finally, Nandhakumar and Jones (1997) sought to better understand the dynamic relationships between executive users and developers in systems development. They did this by examining how these relationships are shaped by various constraints and by looking at the reasons behind user involvement. Giddens's understanding of constraints was used to understand the three main types of constraints that may limit executive user involvement in

systems development—i.e., physical, social and individual constraints. With regard to social constraints, the authors provided a description of power relations and tacitly mentioned the dialectic of control, through which, constraints may also enable action. The duality of structure was explored by looking at the production and reproduction of constraints. In essence, the study highlighted the ‘enabling’ properties of constraints through Giddens’s understanding of agency.

3.7.2 Adaptive Structuration Theory (AST)

DeSanctis and Poole’s (1994) development of AST has considerably influenced IS structural research. The authors proposed AST as an option for the study of advanced IS and the understanding of the role they play in organisational change. The authors argued that AST examines the change process from two vantage points; the types of structures that are given by IS and those that emerge through human interaction with these technologies. The claim, made by DeSanctis and Poole (1994), that the designers of technology incorporate structures into the technology has been criticised by scholars including Orlikowski (2000), and Jones and Karsten (2008), as it contradicts Giddens’s views of the material world; Giddens argued that the material world has no structure and that structures are enacted through human interaction with the material. Poole (2009) responded to this criticism by arguing that structures can take forms other than memory traces and that the question of the material basis of structures is one that is open to debate and question.

AST is organised in a number of concepts, such as appropriation, features, spirit, attitudes towards the technology, and instrumental uses, that were argued by Poole (2009) to be meant to be applied generically rather than in a functional manner as suggested by Jones and Karsten (2008), who stated this to be a criticism of AST; Poole argued for a social constructionist and reflexive view for the application of the concepts. Perhaps the functional label has been given to AST because DeSanctis and Poole (1994) developed the following suggestion, amongst others that have functional tones; *“given advanced information technology and other sources of social structure n_1 to n_k and ideal appropriation processes, and decision processes that fit the task at hand, then desired outcomes of advanced information technology will result”* (DeSanctis and Poole, 1994, p. 131).

DeSanctis and Poole (1994) distinguished between the structural features of the technology and their spirit. Structural features were viewed as bringing meaning and control and were compared with Giddens's concepts of signification and domination, whilst the spirit of the features of technology was explained as the general intent and goals and values, which was compared with Giddens's concept of legitimation. The concept of appropriation is also central to AST and was compared with Giddens's modalities of structuration; appropriation was defined as the visible actions that evidently represent structurational processes. AST also makes references to Giddens's concept of dialectic of control, which is made evident when a group's interaction with a certain technology is not consistent with the structural potential that the technology itself possesses.

3.7.3 Duality of Technology

The duality of technology practice lens developed by Orlikowski (2000) has also proved to be popular within the IS structurational literature. Poole, a co-author of AST, despite taking the view that technology can possess structure, stated that the duality of technology practice lens *"advances the view that structures are not located in organisations or in technology, but are enacted by users. It offers a fluid view of structure that builds on and extends earlier work on structuration"* (Orlikowski, 2000, p. 404). In essence, a main difference between AST and the duality of technology is the ways in which they view technology. AST views it as embodying structure, whilst the duality of technology views it as, at most, containing potential structuring elements, but embodying no structure.

The crux of the argument proposed by the duality of technology is that, when social agents interact with technology in their ongoing practices, they enact structures that, in turn, shape their emergent and situated use of that technology. Orlikowski (2000) argued that this view of technology and structuration is closer to Giddens's understanding of structuration and of the duality of structure. Orlikowski (2000) also argued that understandings of technology and structuration such as those provided by AST create difficulties in two ways. Firstly, by viewing technology as possessing structure, it is presumed to become stabilised, which does not sit with empirical evidence of technology being continually modifiable and alterable even after completion of development. It was argued that a view of technology as being stabilised amounts to determinism, and therefore it was proposed for technology to be viewed as being 'stable for now'. Secondly, stating that structures are embodied in technology explicitly goes

against Giddens's views on the matter, which are as follows; *"a position I want to avoid, in terms of which structure appears as something 'outside' or 'external' to human action. In my usage, structure is what gives form and shape to social life, but is not itself that form and shape—nor should 'give' be understood in an active sense here, because structure only exists in and through the activities of human agents"* (Giddens, 1989, p. 256).

Furthermore, Orlikowski (2000) argued that structures should be viewed as emerging rather than embodied. To overcome the issue of the physical material, Orlikowski stated that whilst a technology may embody certain material and symbol properties, it does not embody structure, as structures can only be instantiated through practice. When social agents engage with a technology, they interact with some or all of the technology's symbol and material properties, and some of these become involved in the process of structuration. It is through this involvement that social structures are then enacted; *"structures of technology use are constituted recursively as humans regularly interact with certain properties of a technology and thus shape the set of rules and resources that serve to shape their interaction. Seen through a practice lens, technology structures are emergent, not embodied"* (Orlikowski, 2000, p. 407).

The duality of technology practice lens also accounts for social change, as every new engagement with technology can result in new structures being enacted. This makes it possible to appreciate Giddens's concept of dialectic of control, as it focuses upon human agency, its interaction with technology, and the results this yields.

The duality of technology has been criticised for being too vague, with a number of its aspects being at odds with Giddens's idea of structuration (Jones and Karsten, 2008). As with other conceptualisations of structuration theory, the duality of technology is selective in its use of concepts. The duality of structure is the main aspect of structuration theory adopted by the duality of technology, while other major aspects have been ignored. Orlikowski (1992) originally developed the duality of technology, with technology defined as material artefacts; these are created and changed by coordinated social action, and are used by social agents to undertake action. In a later conceptualisation, which has been detailed above, Orlikowski (2000) highlighted a difference between technologies in practice and technological artefacts. A reason why Orlikowski's adaptation of structuration theory may not go beyond the duality

of structure is that, at the time of its development, her research was more concerned with arguing against technological determinism and focusing upon the agency side of things, which the duality of structure does aptly.

3.8 Conclusion

To conclude, this study adopts an abductive research logic approach, as explained in section 4.5 of the following chapter. Initial analysis returned themes that resonated well with the concepts of structuration theory. The theory was then adopted as a lens through which the data could be interpreted. While structuration theory has passed through different adaptations in the IS discipline, the original theory developed by Giddens's has been adopted by this study. This study argues that the IS discipline can still gain considerably from going back to the original formulation of structuration theory. This position is also backed by Jones and Karsten (2008), who stated that *"it would, therefore, seem appropriate that we acknowledge how our analysis has been influenced by our own understanding of structuration theory and our interest in engaging closely, but not uncritically, with social theory in our own research"* (Jones and Karsten, 2008, p. 151). The authors further stated that few studies *"show a close relationship between their theoretical stances and Giddens's original formulation of structuration theory"* (Jones and Karsten, 2008, p. 144).

In essence, whereas AST has gone against Giddens's fundamental notion that the physical cannot embody structure, and the duality of technology remains vague and does not go much beyond a limited use of the duality of structure, it remains for IS to go back to Giddens's structuration theory and its enriching concepts; this is what this study does, which is consistent with authors including Barley (1986), Karsten (1995), Lyytinen and Ngwenyama (1992), Sahay and Walsham (1997) and Walsham and Han (1993).

Moreover, the IS literature applying structuration theory needs to become more adventurous in terms of context and the IS researched themselves. It is important for the IS discipline to explore structural processes in broader contexts by looking beyond the traditional organisational setting. The literature needs to be more focused upon those IS phenomena and settings in which structuration theory provides unique insights or findings, which is one of the reasons for the choice of context made for this study. Furthermore, the IS literature has tended to focus upon IS such as groupware and computer-mediated communication; it is

time for IS research to expand into the new technologies that are continually shaping our world. This is one of the reasons why this study is focusing upon a relatively new IS (Jones and Karsten, 2008).

3.9 Summary of Chapter

In summary, this chapter reviewed a number of theoretical perspectives that deal with change, and specifically, social and technological change—namely, Structuration Theory, Theory of Practice, Actor Network Theory (ANT), the Technology Acceptance Model (TAM), and the Punctuated Socio-Technical Information Systems Change (PSIC) Model. The chapter focused considerably more on structuration theory, as this was the theoretical foundation adopted, based on the research logic of this study. The chapter discussed the various ways in which the IS discipline has made use of structuration theory, and argued that there is a need to go back to the theory's original notions. Moreover, it argued that the IS structural literature needs to examine additional contexts and types of IS.

Chapter Four: Research Methodology and Methods

This chapter presents an in-depth articulation of the research methodology and methods selected by this study. The chapter is made up of eleven sections in total; the first section provides a brief introduction and highlights the differences between methodology and methods. The second section details the different philosophical paradigms—namely, positivism, interpretivism and critical realism, and the ontological and epistemological differences between them. The third section presents the underlying philosophical position adopted by this study—namely, interpretivism. The fourth section moves on to the research approach and, by comparing the qualitative and quantitative stances, details the one chosen for this study, which is the former of the two. The fifth section details the research logic of this study. The sixth section specifically highlights the research design and selected methods—namely, the case study method and semi-structured interviews. The seventh section illustrates the data collection process, detailing the case study development, the conducting of the semi-structured interviews, and the collection of online data. The eighth section elaborates on how the collected data were coded and analysed. The ninth section presents an evaluation of this study, based upon guidelines for conducting qualitative interpretivist research. Section ten, explains the ethical issues that were considered by this study. The final section, section eleven, presents the summary of the chapter.

4.1 Introduction

In any research investigation, selecting the appropriate research methodology and methods is imperative because of the important role played by empirical data in pursuing the research objectives; therefore, providing justification for the choice of methodology and methods is one of the major aims of this chapter. The methodology and methods were specifically selected to address the various shortcomings in the existing literature that were highlighted in previous chapters of this research. Through its meticulously chosen methodology and methods, this study is able to go beyond the existing literature and make an exciting contribution to the IS crowdsourcing literature.

4.1.1 Methodology and Methods

Methodology and methods are crucial to social research because they set apart research from intuition, rumour or opinions. Social research can be defined as *“a collection of methods and methodologies that researchers apply systematically to produce scientifically based*

knowledge about the social world" (Neuman, 2006, p. 2). Social research is a systematic process of discovery and a way in which researchers find answers to questions. To further clarify what is meant by social research, Neuman (2013) highlighted some of the alternative avenues of investigation that people follow to acquire knowledge—e.g., popular and media messages, ideological values and beliefs, common sense and personal experience, and authorities or experts (Neuman, 2013, p. 2). The author then argued that social research is the most systematic, organised and structured way to gain knowledge. Furthermore, he stated that social research should not be perceived as a threat to faith, as it is just one of the many ways in which knowledge can be acquired.

Although the two terms 'methodology' and 'methods' can be and have been assumed to be synonymous, there are differences between their meanings that it is important to clarify. 'Methodology' has a broader scope than 'methods'; in fact, the former encapsulates the latter. 'Methodology' involves *"understanding the entire research process—including its social-organizational context, philosophical assumptions, ethical principles, and the political impact of the new knowledge from the research enterprise"* (Neuman, 2013, p. 2). On the other hand, the term 'methods' refers to *"the collection of specific techniques we use in a study to select cases, measure and observe social life, gather and refine data, analyse data, and report on results"* (Neuman, 2013, p. 2). Therefore, although these definitions are closely linked and interdependent, there are clear differences between them (Cassell and Symon, 2004; Hackley, 2003; Neuman, 2013; D. Silverman, 2013).

4.2 Philosophical Paradigms

Collier (1994), rhetorically asked why researchers should bother with philosophy when conducting research. Answering this question simplistically, he stated that an understanding of the different philosophical paradigms is important because it enables researchers to powerfully argue for their selected research approaches and confidently choose their 'spheres of activity' (Dobson, 2001; Easterby-Smith et al., 2002; Lee, 2004). Furthermore, discussing the importance of beginning social research with philosophical considerations, Guba and Lincoln (1994) stated that *"questions of method are secondary to questions of paradigm, which we define as the basic belief system or world view that guides the investigation, not only in choices of method but in ontologically and epistemologically fundamental ways"* (Guba and Lincoln, 1994, p. 105). Adding to this, Walsham (1995) stated

that “researchers need to reflect on their own philosophical stance, which should be stated explicitly when writing up their work” (Walsham, 1995, p. 76).

Ontology and epistemology are the two philosophical assumptions that differentiate the paradigms. All research is based on philosophical assumptions, regardless of whether these are mentioned explicitly; this is because philosophical assumptions influence the selection of the methods and of the approach to theory. Many scholars have argued that rigorous research should explicate the philosophical assumptions upon which it is based (Walsham, 1995, 2006). In essence, the research philosophy adopted by an author denotes the views that he or she holds in regard to the world, knowledge, and how knowledge is gained.

From an analysis of research papers dating from 1983 to 1988, Orlikowski and Baroudi (1991) found that the dominant philosophical paradigm used by researchers within the IS literature is the positivist one. The following decades have not seen much change in this situation or trend (Myers and Klein, 2011; Tsang, 2014; Wynn and Williams, 2012). This having been said, the IS discipline has seen a change in its attitude towards interpretivist research. In 1989, the MISQ editorial issue had stated that *“a paper in the Theory and Research category should satisfy the traditional criteria for high quality scholarly research. It should be based on a set of well-defined hypotheses, unbiased and reproducible procedures for collecting evidence that supports or refutes the hypotheses, and sound analytical procedures for drawing appropriate conclusions from the evidence”* (Emery, 1989, p. xi). Having thus clearly argued for positivist based research in 1989, a few years later, in 1993, the MISQ editorial issue stated that *“on the empirical side, we welcome research based on positivist, interpretive, or integrated approaches. Traditionally, MIS Quarterly has emphasized positivist research methods. Though we remain strong in our commitment to hypothesis testing and quantitative data analysis, we would like to stress our interest in research that applies interpretive techniques, such as case studies, textual analysis, ethnography, and participant observation”* (DeSanctis, 1993, p. vii). This highlighted a shift in the IS literature towards welcoming interpretivist research.

Another debate regarding philosophical paradigms within the IS literature saw an attempt to reconcile the differences between positivism and interpretivism. Weber (2004) argued that many of the alleged meta-theoretical differences between the two paradigms are non-existent. The author claimed that, rather than being major meta-theoretical ones, most of the

differences are instead to be found in the chosen research methods. Weber (2004), further contended that *“it is time to assign the rhetoric of positivism versus interpretivism to the scrap heap. It no longer serves a useful purpose. On the contrary, it promotes unhelpful schisms among scholars. It also leads to analyses that in my view are fundamentally flawed and vacuous. Moreover, it promotes prejudice instead of alleviating it when we engage in an evaluation of a piece of research”* (Weber, 2004, p. xi). This having been said, it is still important to understand the differences between the two paradigms; this is acknowledged by Weber (2004), who stated that we should understand them but not allow them to divide us. Thus, the following paragraphs shed light upon the three main philosophical perspectives: positivism, interpretivism and critical realism.

4.2.1 Positivism

Positivist research is conducted through structured instrumentation and seeks to investigate fixed relationships between phenomena. Positivist research in IS can be characterised by the testing of hypotheses, the quantifiable measuring of variables, the formalising of propositions and the staking of generalised claims about phenomena by means of the sampling of a population. Furthermore, positivist studies generally aim at testing theory (Myers, 2012; Orlikowski and Baroudi, 1991). Positivism adopts the *“Humean conception of causality which treats the constant conjunction of events as an indicator of a causal relationship”* (Tsang, 2014, p. 175). Moreover, it follows the covering-law model of explanation proposed by Hempel (1965).

In terms of its ontological position, positivism assumes the existence of an objective social and physical world independent of human beings, which can be apprehended, characterised and measured in an orderly fashion. The structures and reality of an organisation are assumed to exist unrelatedly to its members. The positivist researcher does not intervene in any way, playing instead a passive role and aiming at uncovering the objective social and physical reality by means of specific measurements. Positivism assumes that human action is, at the very least, boundedly rational, but mostly rational and intentional. In terms of social reality, it is assumed that conflict is not widespread in organisations and society but that, if it does occur, it highlights an incongruity in the social system.

Epistemologically, the positivist paradigm centres around the empirical testability of theory, either through its falsification or verification. Positivism aims at not disturbing the phenomena being studied; instead, it quietly goes about collecting data to understand it by employing methods such as surveys or questionnaires. The pursuit of such 'sanctioned methodologies' as the only way in which to obtain valid knowledge has been described as 'methodological monism'. The empirical testability of theory, known as the 'hypothetic-deductive account of scientific explanation', has two main consequences:

1) The forming of lower level hypotheses may come about through the search for universal principles or laws. In essence, positivism undertakes deductive research to uncover unilateral, causal relationships that become the basis of generalised knowledge.

2) Positivist research assumes the existence of a tight coupling between prediction, explanation and control. The prediction or control of an event is enabled by the prior knowledge of specific principles and premises. This is because an event can only be explained when it is deduced from such principles or premises (Chua, 1986; Gibbons, 1987; livari, 1991; livari et al., 1998; Orlikowski and Baroudi, 1991).

The paradigm employs statistical methods to analyse data as a major way in which to establish a nomothetic knowledge body. Positivist research tends to adopt quantitative methods—such as experiments, archival data and questionnaire surveys—and, since positivism depends on correlations between variables to suppose causation and identify empirical regularities, the reliability of its results increases with the sample size (Tsang, 2014). This type of research presents many limitations that have been detailed in the literature. The two major concerns are that, in the pursuit of universal laws, any historical and contextual conditions that may have an effect upon human actions are either ignored or disregarded. Ignoring such influences may lead to an incomplete, inaccurate, or simply incorrect understanding of IS (Orlikowski and Baroudi, 1991). Furthermore, as they adopt a circumscribed and predefined stance towards phenomena, positivist studies are deterministic and do not allow for the explanation of nondeterministic relationships. In essence, as highlighted by Rowan (1973), positivist research only answers the questions that the researcher specifically focuses upon and ignores phenomena that may actually be more important.

Popular positivist researchers within the IS discipline include Benbasat et al. (1987), Dubé and Paré (2003), and Lee (1989b). Historically, IS research has been based on the positivist stance; *“positivism remains dominant in the main U.S.-based journals such as MISQ and ISR in terms of the percentages of published papers”* (Walsham, 2014, p. 13). Furthermore, Walsham (2014) argued that the shadow of the positivist perspective continues to influence interpretivist research, to the extent that the latter is not too distant from the positivist approach, which involves the empirically based testing of hypotheses. For example, Walsham (2014) argued that Klein and Myers (1999) influential interpretivist study, in which steps for the undertaking of interpretivist research are proposed, still has a ‘neo-positivist flavour’ to it (Walsham, 2014).

4.2.2 Interpretivism

Interpretivism developed as a reaction to the dominance of positivist research within IS and the social sciences as a whole. Interpretivist research is philosophically based upon phenomenology and hermeneutics and attempts to understand phenomena through the eyes of the researcher via assigned meanings. Interpretivist research is nondeterministic and does not define or predefine variables (either dependent or independent); rather, it focuses on the range of social complexities associated with human beings. Interpretivist researchers strive to *“piece together people’s words, observations and documents into a coherent picture expressed through the voices of the participants”* (Trauth and Jessup, 2000, p. 54).

Ontologically, interpretivism stresses the importance of subjective meanings in the processes by which human beings build and construct their social realities; an important difference between positivism and interpretivism is that the latter rejects the notion that events should be understood objectively or factually, offering instead a relative or subjective perception of them. Rather than assuming that social relations and organisational structures are objectively knowable, interpretivism seeks to define how and why human beings give the social world meaning through participation and interaction. Furthermore, interpretivism assumes that the social world does not exist independently of human beings and that it therefore cannot be measured objectively; rather, that it is produced and reinforced through human action and is not ‘given’, as presumed by positivism. Whereas positivism assumes that the social world can be discovered, interpretivism assumes that it can only be interpreted (Morgan, 1983; Myers, 2012; Orlikowski and Baroudi, 1991).

In terms of its epistemological position, interpretivism centres on getting inside the world of those who generate knowledge. This epistemological position differs from that of positivism as it assumes that social processes cannot be captured by hypothetical deductions, degrees of freedom, or covariances. Interpretivism does not argue for a disjuncture between everyday social practices and the language used to describe them; *“understanding social reality requires understanding how practices and meanings are formed and informed by the language and tacit norms shared by humans working towards some shared goal”* (Orlikowski and Baroudi, 1991, p. 14). Interpretivism avoids imposing any externally defined categorisation on phenomena and, instead of coming to the field with defined constructs or categories, it aims at developing these from exposure to the social world being investigated. In essence, the fundamental principle of interpretivism is that *“individuals act towards things on the basis of the meanings that things have for them, that meanings arise out of social interaction, and that meanings are developed and modified through an interpretive process”* (Boland, 1979, p. 260; Gregor, 2006; Myers, 2012).

Interpretivist research methods in IS aim at providing an understanding of the subject and explore the processes by which these can be influenced by or themselves influence different contexts (Klein and Myers, 1999; Myers, 2012; Walsham, 1995). These methods include case, ethnographic, ethnomethodological, and phenomenographic studies (Weber, 2004).

Popular interpretivist researchers within the IS discipline include Klein and Myers (1999), Boland (1991) and Walsham (1995). In particular, Walsham (1995) has been credited with developing the standards of interpretivist research within the IS discipline (Stahl, 2014). However, Stahl (2014) argued that some of the core elements proposed by Walsham (1995) in regard to how to conduct interpretivist research go against the philosophical roots of interpretivism, whilst also questioning the perspective in a broader and more general sense. Whilst arguing for non-empirical based research that is more in keeping with the roots of interpretivism and criticising Walsham for not adhering to these roots, Stahl (2014) stated that the IS discipline needs to reconsider and expand its boundaries of legitimacy; this, Stahl (2014) argued, would lead to more colourful, rich, and interesting interpretivist research. Walsham (2014) responded to Stahl (2014) by stating that non-empirical based interpretivist research would be considered unacceptable in the discipline, as many top journals, including MISQ, explicitly call for an empirical based approach. He further argued that the leap from

empirically based positivist to empirically based interpretivist research was already considered to be a big one, and that the further leap to non-empirical interpretivist research would have been even greater.

4.2.3 Critical Realism

Critical realism, originally developed by Bhaskar (1975, 1998) has been argued to be a credible alternative to the positivist and interpretivist philosophical perspectives in IS and in the social sciences in general. Critical realism takes elements from both the positivist and interpretivist philosophical perspectives; it specifically acknowledges the existence of independent structures that can enable or constrain actors in the pursuit of their actions, and also accepts the role played in everyday situations by the subjective knowledge of social actors. The critical realist perspective enables a detailed explanation of the causal relationships within a given set of phenomena or events through the interpretations and structures of the social agent. It has been described as a means to transcend the inconsistencies of both the positivist and interpretivist philosophical perspectives (Smith, 2006).

Regarding its ontological position, critical realism assumes the existence of an independent reality—namely, a stratified ontology entailing mechanisms, events, experiences and structures (Wynn and Williams, 2012). In terms of the objective or subjective reality, critical realism positions itself somewhere in-between positivism and interpretivism; it argues that the social world is independent of human knowledge while, at the same time, it is not easily characterised or measured. The social world is part of an intransitive dimension that operates independently of social agents, and the knowledge, beliefs, and causalities that researchers develop in regard of it are constantly subject to reinterpretation and revision. In terms of stratified ontology, critical realism proposes the stratification of reality into three domains—i.e., real, actual and empirical. This stratified ontology is different to both positivism and interpretivism. Positivism assumes a flat ontology that reduces reality to cause and effect, with no interest in the mechanisms that link them. Interpretivism holds the ontological view that reality can only be viewed through human actions and meanings; some interpretivists even hold the view that reality does not exist independently of human knowledge. Critical realism on the other hand, argues that there is an independent reality made up of structures and mechanisms, but that our knowledge of these is limited due to the difficulty in assessing them caused by stratification. In essence, critical realism holds the view that a socially

constructed view of reality may not always be correct in regard to the intransitive domain of an independent or objective reality (Dobson, 2001; Gregor, 2006; Smith, 2006; Wynn and Williams, 2012).

With regard to its epistemological position, critical realism argues more for 'multi-dimensionality' in understanding the social world. It seeks to construct descriptions of reality based on the experiences of participants, through an interpretivist analysis of these experiences. This is added to other types of data and the resulting knowledge claims are focused on articulating those elements of reality that must exist in order for the observed experiences of participants to have taken place (Wynn and Williams, 2012). Wynn and Williams (2012), also highlighted five epistemological assumptions, which are: mediated knowledge, explanation rather than prediction, explanation via mechanisms, un-observability of mechanisms, and multiple possible explanations. Furthermore, epistemologically, critical realism accepts that knowledge of the social world can be represented theoretically and is fallible. Therefore, knowledge is not developed from scratch; rather, it is a product of the socio-historical environment (Bhaskar, 1975, 1998).

Despite the argument that proposes critical realism as a credible alternative to positivism and interpretivism, there is minimal IS literature that provides guidelines on how to undertake effective critical realism based research. Typical research methods adopted by critical realist researchers include case studies (Zachariadis et al., 2013). Popular critical realist researchers within the IS discipline include Morton (2006), Volkoff et al. (2007), and Bygstad (2010).

4.3 The Positioning of this Study

The underlying philosophical perspective adopted by this study is interpretivism. This is because the interpretivist paradigm is consistent with the author's world view and beliefs—namely, that access to reality is realised through social constructions, including shared meanings, language and consciousness. Additionally, social phenomena are complex entities; therefore, the author has to be involved in and cannot be independent of the phenomena themselves.

Scholars, including Guba and Lincoln (1994), and Walsham (1995), have emphasised that an investigation is guided by its philosophical paradigm and assumptions, and that the questions of method are secondary to those of philosophy. This is made evident through this study's

use of structuration theory, which is a theoretical foundation that fits with the author's world view. Interpretivism and structuration theory are suitably mutually compatible, as demonstrated by means of an examination of the theory's implementation within the IS literature. IS scholars who have adopted structuration theory in an interpretivist manner include Walsham and Han (1993), Karsten (1995), Sahay and Walsham (1997), and Barley (1986), who are also among the most popular exponents of structuration theory within the IS literature.

4.4 Research Approach

Based on its aims and objectives, adopted theoretical foundation, and the shortcomings identified within the existing crowdsourcing literature, this study adopts a qualitative approach.

The qualitative approach was *"developed in social sciences to enable researchers to study social and cultural phenomena"* (Myers, 2012). The main motivation behind qualitative research is that it helps to understand people and the social and cultural contexts in which they operate. The qualitative research method capitalises on the fact that the difference between human beings and the natural world is the former's ability to speak (Cassell and Symon, 2004; Denzin and Lincoln, 2000, 2011; Symon and Cassell, 2012). This view is backed by Kaplan and Maxwell (2005), who stated that the *"goal of qualitative research is understanding issues or particular situations by investigating the perspectives and behaviour of the people in these situations and the context within which they act"* (Kaplan and Maxwell, 2005, p. 30). They also argued that, when textual data are quantified, the phenomena surrounding people and the social and cultural contexts in which they operate are largely lost; for this reason, this study does not adopt a quantitative approach.

Scholars, including Van Maanen (1998), have argued that qualitative research can be difficult to pin down due to its flexible and emergent nature. Furthermore, qualitative research is frequently designed and re-designed while it is being undertaken due to unexpected events and requires *"highly contextualized individual judgments"* (Van Maanen, 1998, p. xi). Gephart (2004) stated that qualitative research can be better pinpointed and clarified by comparing it with quantitative research. The comparison shows that the main advantage of the qualitative method is that people involved in it can openly describe their opinions and express

themselves. This is very important, as the quantitative approach limits this freedom, and may thus hinder the gathering of comprehensive responses. The qualitative approach also allows for direct contact with respondents, which gives the researcher a first-hand account of what is going on (Echtner and Ritchie, 1991).

Qualitative interpretivist research relies on words and speech to create text based accounts of people's views of reality and narrates these views in regard to who said what, why, when and how. More often than not, qualitative interpretivist research is descriptive in nature, and processes are detailed through the emphasis that is placed on situational details that unfold over a period of time; *"an important value of qualitative research is description and understanding of the actual human interactions, meanings, and processes that constitute real-life organizational settings"* (Gephart, 2004, p. 455) Furthermore, the qualitative interpretivist researcher aims at providing well-corroborated conceptual insights that explain research observations; this is another difference with quantitative research, as the latter uses a hypothetical-deductive model which tests general propositions and reveals important relationships between variables (Denzin and Lincoln, 2000, 2011; Gephart, 2004; Symon and Cassell, 2012).

Quantitative research, which is normally based on positivism, enforces scientific denotations to explain a singular reality that is assumed to be absolutely true. This type of research counts, quantifies and codes phenomena in an attempt to represent concepts, and is therefore grounded in statistical and mathematical knowledge. In comparison, qualitative research has a humanistic and literary focus; it relies on people's meanings and explanations to explicate directly how they experience their everyday realities, which, in essence, is a focus on the socially constructed nature of reality. In other words, qualitative research relies on words, texts and talk as a way to represent concepts. This is important for a number of reasons, as qualitative research provides insights that are difficult or near impossible to obtain through quantitative research. Gephart (2004) articulated this in an effective manner; *"qualitative research can provide thick, detailed descriptions of actual actions in real-life contexts that recover and preserve the actual meanings that actors ascribe to these actions and settings... qualitative research has potential to rehumanize research and theory by highlighting the human interactions and meanings that underlie phenomena and relationships"* (Gephart, 2004, p. 455).

According to Kaplan and Maxwell (2005), there are five main reasons for the use of qualitative research in IS. These are: to understand how the users of a system perceive and evaluate it and what it means to them; to understand the system in the context of social and organisational influence; to investigate casual processes and how they work; to provide a means of evaluation and improvement that enables the system to be improved whilst under development, rather than when it is completed; and to enable a greater utilisation of the evaluation results.

To summarise the benefits of qualitative research, Miles (1979) stated that *“qualitative methods yield data that are ‘rich, full, earthy, holistic, ‘real’; their face validity seems unimpeachable; they preserve chronological flow where that is important, and suffer minimally from retrospective distortion... Furthermore their collection requires minimal front-end instrumentation”* (Miles, 1979, p. 590).

4.5 Research Logic and the Adoption of Structuration Theory

This study undertook an abductive research logic approach. The abductive research logic process essentially combines inductive and deductive steps (Alvesson and Skoldberg, 2009; Klag and Langley, 2013). The label ‘abduction’ has been drawn on by scholars as inherent to discovery-oriented research, and because of the somewhat misleading label of ‘induction’ (Agar, 2010; Locke et al., 2008). An abductive research logic approach *“helps to remedy some of the problems with a strict inductive approach”* (Agerfalk, 2001, p. 220). It has been argued that ‘induction’ can suggest *“a form of naïve empiricism that ignores the inevitable contribution of pre-existing theoretical ideas (however amorphous) to emerging insights as well as underplaying the role of imagination”* (Klag and Langley, 2013, p. 151). In essence, this study did not follow either the inductive or deductive research logic approach on its own, but rather combined them, in the sense that at the initial stages a number of theoretical ideas were explored and kept in mind, and when the initial collected data resonated with structural concepts, structuration theory was adopted. This approach has been backed by scholars and is consistent with the views of those that argue of the inseparability of both logics (Whetten, 1989). For example, Fine (2004) argues that *“it is not possible to separate deduction and induction in the way that has been suggested, particularly as regard to field research”*, and that *“the inductive and deductive models of research can never be disentangled”* (Fine, 2004, pp. 5, 11).

According to this logic, this study explored a number of theories related to change, and specifically, social and technological change. With these theories in mind, the data collection stage proceeded, and the initial data was categorised into descriptive codes and then grouped into themes. The initial themes were looked at broadly, in light of the explored theories. Initial themes resonated well with concepts from structuration theory. It was at this point that the author adopted structuration theory as the theoretical foundation, through which crowdmapping may be understood and explained. More in-depth data was then collected; this is in line with Walsham (1995). The following table shows the study's emerging themes mapped to concepts from structuration theory.

Table 6 - Themes from data mapped to concepts from structuration theory

<u>Themes from Data</u>	<u>Concepts from Structuration Theory</u>
- Enhancing Credibility	- Signification / Meaning
- The role of the crowd - Crowd conflicts - Control	- Domination - Knowledgeability - Reflexivity - Rationalisation of Action - Dialectic of Control - Relational Power - Allocative Resources
- Gaining Legitimacy	- Legitimation
- Crowdmapping Challenges - Crowdmapping management - Crowd ambiguity	- Knowledgeability - Reflexivity - Rationalisation of Action
- Crowd eagerness-to-know - Crowd monitoring of results - Crowd interest in results	- Knowledgeability - Reflexivity - Rationalisation of Action

Appendix 5 presents a full list of the data analysis descriptive codes used by this study, while appendix 6 details the themes from the data, based on the descriptive codes in appendix 5, mapped to concepts of structuration theory. Moreover, appendix 6 details the corresponding section of the analysis chapter, and presents examples from the data.

Importantly, the role of theory adopted by this study is consistent with the recommendations by IS interpretive scholars including Walsham (1995, 2006), and guidelines by the latter were

closely followed throughout. For example, the initial openness to theories by this study is consistent with Walsham (1995); *“there is a danger of the researcher only seeing what the theory suggests, and thus using the theory in a rigid way which stifles potential new issues and avenues of exploration. It is desirable in interpretive studies to preserve a considerable degree of openness to the field data, and a willingness to modify initial assumptions and theories. This results in an iterative process of data collection and analysis, with initial theories being expanded, revised, or abandoned altogether. A simple metaphor for this latter case is the use of scaffolding in putting up a building, where the scaffolding is removed once it has served its purpose”* (Walsham, 1995, p. 76). Furthermore, Walsham (2006) argued that the choosing of theory in interpretive research lies in the experiences, background and interests of the researcher. This being said, justification for choosing theory is incumbent on the researcher, and for this study, structuration theory was adopted after it resonated with the initial and subsequent data, ultimately offering insights into the phenomenon that other theories could not.

Moreover, the role of theory adopted by this study is consistent with the scholarly work in leading IS journals. For example, in their investigation of qualitative research in the IS discipline between 2001 and 2012 in the leading IS Journals, MISQ, ISR, JMIS and JAIS, Sarker et al. (2013) *“found a wide variety of theories used up front (i.e., prior to data analysis/interpretation) in the reviewed papers, such as structuration theory, practice theory, institutional theory, and situated learning theory”* (Sarker et al., 2013, p. vi). Also, in terms of the classification of theory in IS by Gregor (2006), this study closely follows ‘using theory for explanation’. As argued by the author, *“this type of theory explains primarily how and why some phenomena occur”* (Gregor, 2006, p. 624).

In essence, structuration theory was one of the theories that was initially explored by this study. Once the initial data collection was undertaken, and it was seen that the collected data resonated with structural concepts, the theory was applied as a theoretical lens and ‘sensitising device’. This is also consistent with the views of Klein and Myers (1999), who argue that *“interpretive researchers are not so interested in ‘falsifying’ theories as in using theory more as a ‘sensitizing device’ to view the world in a certain way”* (Klein and Myers, 1999, p. 75). In the case of this study, structuration theory was used to view crowdmapping in a certain way.

4.6 Research Design and Selected Methods

The primary qualitative methods adopted by this study consist of a case-study with semi-structured interviews. Research methods are fundamental in the production of knowledge in any discipline (Pinsonneault and Kraemer, 1993). Research methods “*shape the language we use to describe the world, and language shapes how we think about the world*” (Benbasat and Weber, 1996, p. 392).

4.6.1 Case Study

This study follows the interpretivist case study tradition of Walsham (1995, 2006). Interpretivist case studies provide detailed understandings of phenomena, and recognise the subjectivity that the researcher brings to the investigation. Walsham (1995), stated that the value provided by the explanation of phenomena is judged by the extent to which the phenomena is understood by others and by the extent to which it makes sense to those that are being studied.

The case study is the most widely used qualitative research method within IS; it has grown to the extent that its validity is rarely ever questioned (Lee and Hubona, 2009; Orlikowski and Baroudi, 1991). Case studies have proven to be beneficial in understanding IS development, implementation and usage. Although this study advocates interpretivist case research, Yin (1994), an advocate for positivist case research, provided a credible definition of the case study “*as an empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident... and it relies on multiple sources of evidence*” (Yin, 1994, p. 13). Furthermore, Eisenhardt (1989), albeit also being an advocate for positivist case research, stated that the case study is an appropriate research strategy in which “*the focus is on understanding the dynamics present*” (Eisenhardt, 1989, p. 534).

Case studies focus on achieving an in-depth understanding of phenomena and context by combining different data collection methods such as interviews, documents and other sources. Within research, case studies can be conducted for various purposes, depending on the philosophical paradigm that a particular study is based upon; these purposes include the development or testing of theory, or the provision of a detailed understanding of phenomena (Cavaye, 1996). Popular positivist case researchers include Yin (1994) and Eisenhardt (1989),

popular interpretivist case researchers include Walsham (1995), whilst popular critical realist case researchers include Wynn and Williams (2012).

4.6.1.1 Generalising from Case Study Research

A criticism and a somewhat contentious issue pertaining to case study research is that case findings are not readily generalisable, with the argument differing based upon the philosophical stance taken by researchers. Positivist case studies are normally based on small samples; therefore, the explication of law-like relationships is minimal. Yin (2009), argued that the attempted generalisation of case studies by statistical means is inappropriate; he argued that cases should be treated as experiments and not sampling units. This argument has been further reinforced by other positivist case researchers including Lee (1989a).

There are various views on the generalisability of case studies within the interpretivist paradigm. Lincoln and Guba (1985) argued that generalisation is not possible in qualitative research and, instead, developed the term 'fittingness'; *"the aim of inquiry is to develop an idiographic body of knowledge. This knowledge is best encapsulated in a series of 'working hypotheses' that describe the individual case. Generalizations are impossible since phenomena are neither time- nor context-free"* (Lincoln and Guba, 1985, p. 238). They further argued that generalisation is not possible because human behaviour is heavily mediated by the context in which it occurs and to make context-free generalisations would not accurately represent it. This view was also backed up Denzin (1983), who although arguing on the basis of different rationale, stated that social life is far too variable and inherently indeterminate to enable generalisations from a single specific instance of a phenomenon. Each instance of a phenomenon has its own structure, meaning and logic, which have to be explored hermeneutically, and each instance is composed of multiple layers that have different meanings and frequently contradict each other. In essence, Denzin (1983), argued that *"the interpretivist rejects generalization as a goal and never aims to draw randomly selected samples of human experience"* (Denzin, 1983, p. 133).

Another group of interpretivist researchers argued that it is possible to generalise from case research; however, the nature of this generalisation differs from that of positivist research. Authors, including Stake and Trumbull (1982), argued for 'naturalistic generalisation', which differs from the mainstream understanding of generalisation; Tsang (2014), reinforced this

point by stating that *“naturalistic generalization is inconsistent with the meaning of generalization”* and that what the authors are actually proposing is inductive analogy (Tsang, 2014, p. 178). Nevertheless, Stake and Trumbull (1982) argued that case readers are able to understand the extent to which an existing case can be used to understand new settings.

Arguing for generalisation, more in the sense of the literal meaning of the word, Walsham (1995) reasoned in favour of four different types of generalisation: contribution of rich insight, drawing of specific implications, generation of theory, and development of concepts. Tsang and Williams (2012) argued that, out of the four propositions above, only two fit the literal meaning of generalisation—namely, drawing of specific implications and generalisation of theory. Contribution of rich insight does not accurately fit the meaning of generalisation because not all insights infer generalisation. Development of concepts differs from the meaning of generalisation due to the ambiguity surrounding developed concepts in terms of definitiveness. Lee and Baskerville (2003, p. 233) attempted to clarify the misconceptions of generalisability and offered advice on four types of generalising: from empirical statements to other empirical statements, from empirical statements to theoretical statements, from theoretical statements to other theoretical statements, and from theoretical statements to empirical statements.

Finally, critical realism, whilst not arguing against generalisation, holds the view that conditions of closure are seldom achievable (Tsang, 2014; Tsang and Williams, 2012).

4.6.2 Semi-Structured Interviews

The interview has been argued to be the most common research method in qualitative research as a whole. Rubin and Rubin (2005) argued that the qualitative interview enables the researcher *“to see that which is not ordinarily on view and examine that which is looked at but seldom seen”* (Rubin and Rubin, 2005, p. vii).

In qualitative research, there are two main types of interview: unstructured and semi-structured. Semi-structured interviews enable the researcher to gain various different insights into how participants view the world. This is due to their comparatively unstructured nature; unlike fully structured interviews, semi-structured ones usually follow a research guide or specific set of questions with considerable leeway. This provides great flexibility as to what the researcher can ask, as a function of the respondent’s answers, and what the

researcher thinks will best enable him/her to understand the phenomenon. Both the researcher and interviewee play an active role in the construction of knowledge and, because of the nature of the interview, the interaction can establish an empathy that can increase the respondent's interest in the research. Further benefits of the semi-structured interview include the validity of data, as they can be checked for accuracy (Bryman, 2012; Burton, 2000; Hair et al., 2003; Mason, 2002; Neuman, 2005; D. Silverman, 2010).

Specifically arguing for the importance of the interview for the case study method, Walsham (1995) stated that *"with respect to interpretive case studies as an outside observer, it can be argued that interviews are the primary data source, since it is through this method that the researcher can best access the interpretations that participants have regarding the actions and events which have or are taking place, and the views and aspirations of themselves and other participants"* (Walsham, 1995, p. 78).

4.7 Data Collection

This section details how data were collected and highlights the various challenges that were faced during the collection phase. Initially, a case study was developed on crowdmapping in the context of humanitarian response over the 2009-2015 period. This was done using secondary data, followed by primary data to build up a more detailed understanding. This section details how the initial case of crowdmapping in the context of humanitarian response was developed and how the subsequent semi-structured interviews were carried out.

Temporality, or time, is central to any conceptualisation of change, and Giddens (1984) made apt reference to time throughout his writings on structuration theory; specifically, he argued that time serves as a basis upon which social structure is produced or reproduced. Therefore, the importance of temporality was central to this study's exploration of the impact of crowdmapping; hence the exploration of crowdmapping from 2009 to 2015. Another important aspect taken into consideration by this study was the longitudinality of the data; this was imperative to understand how processes or, more specifically, the effects of action unfolded over time. Therefore, it was important for the collected data to cover a period long enough for the effects of action to be accurately understood.

4.7.1 Case Study Development – Crowdmapping in the Context of Humanitarian Response

In one of their recommendations for case study development, Pan and Tan (2011) stated that the researcher should “*develop a mental concept of the phenomena*”. The authors advocated the recommendation made by Strauss and Corbin (1998), who stated that the researcher should turn to ‘non-technical literature’—such as newspapers, letters, and biographies—in order to develop this mental concept. Therefore, taking this recommendation into consideration, this study used a number of varied sources—including reports, news items, blog posts, television interviews, and video recordings—to build up the initial case study of crowdmapping in the context of humanitarian response. The sources included official documents from the American Red Cross and OSM to complement the primary data. An example of this included an OSM damage assessment report for the Haiyan response that was conducted by the REACH Initiative and the American Red Cross, with funding from the Office of United States Foreign Disaster Assistance (OFDA). The report was examined and its implications were further explored through primary interaction with actors, including OSM governance and American Red Cross actors. Further reviewed documents included UN OCHA reports on alternative sources of imagery.

The recommendation made by Strauss and Corbin (1998) was particularly beneficial because a number of the key events in the case study, such as crowdmapping during Haiti and Haiyan, received a considerable amount of coverage, which helped to develop the initial picture. The information that was gathered in regard to the phenomenon served as a basis for the initial development of the interview questions. When the data collection phase was about to begin, Haiyan was the most recent significant response, and it therefore served as a good starting point for the research.

4.7.2 Undertaking Semi-Structured Interviews – HOT, OSM and Humanitarian Actors

The OSM Haiyan contributor list webpage was examined and various contributors were sent emails explaining the study’s research objectives and expressing the desire to interview them. Interviews were conducted with OSM contributors, and with participants from the different organisations involved. In total, 43 interviews were conducted, with 41 unique participants; 21 interviews with organisational actors, and 22 with OSM contributors.

Interviewed actors included those from the HOT community, and various humanitarian organisations, including the American Red Cross, UN OCHA, MapAction, and specialists from NEDA. Further interviews were conducted with relevant actors from DigitalGlobe and Mapbox. The voice interviews were conducted between August 02, 2014, and July 20, 2015, and ranged in duration between 16m40s and 96m36s, with an average of 47m31s; they were recorded and transcribed verbatim. Table 7 presents a breakdown of the type of interviewee and the number with each type. Table 8 presents details on the 43 conducted interviews.

A contributor kindly sorted the list of interviewees in terms of the number of contributions that each had made; this enabled the author to easily see which contributors had been most involved. Furthermore, it was imperative that the governance actors of OSM Haiyan were interviewed; fortunately, all three activators of that initiative made themselves available and their interviews proved to be very insightful. After the contributors had been emailed, their initial response was very positive. The majority of contributors agreed to voice interviews, although others asked that the questions be sent via email. It should be noted that although prominent contributors and governance actors in the Haiyan response had been selected, the questions went beyond Haiyan.

In total, 43 voice and video interviews were conducted, while email communication was held with nine other participants. The voice and video interviews were conducted over Skype, as the geographical locations of the contributors were too spread out to meet face-to-face. This presented some disadvantages, as the author missed out on body language and gestures; nevertheless, it is in the nature of crowdsourcing initiatives that contributors hail from all parts of the world. To illustrate this, suffice it to say that, at the time of interview, the three governance actors of the OSM Haiyan initiative resided in three different countries – North Dakota, United States; Montreal, Canada; and Manila, Philippines (table 8 further highlights the geographical spread of interviewees). In effect, conducting interviews over Skype can also present some advantages—namely, that interviewees answer more openly as they don't find themselves in a 'formal' environment; many of the interviewees that took part in this study did so from the comfort of their own homes. The author conducted the interviews from a private library room at Royal Holloway, University of London.

Table 7 - Type of interviewee and number

<u>Type of Interviewee</u>	<u>Number of Interviews</u>
OSM Contributors	22
Organisational Actors	21

Table 8 - Breakdown of the 43 semi-structured interviews

<u>Interview Number</u>	<u>Organisation/Role of Interviewee</u>	<u>Occupation of Interviewee</u>	<u>Location of Interviewee (City/Country)</u>	<u>Interview Length (mins.secs)</u>
1.	HOT Activator	Software Engineer, Unemployed	North Dakota, United States	96.36
2. (Interviewed Twice)	HOT Activator	Computer Scientist, Retired	Montreal, Canada	58.01 and 34.08
3. (Interviewed Twice)	HOT Member	GPS Data Analysis Expert, placr.co.uk	London, UK	50.03 and 52.21
4.	OSM Contributor	Senior Java Developer, NAUMEN	Igalo, Montenegro	46.10
5.	HOT Member	HOT Founding Member, Presidential Innovation Fellow	Washington DC, United States	41.37
6.	OSM Contributor	Unemployed, Recently Completed Masters.	Prague, Czech Republic	42.17
7.	Mapbox	Open Data Expert	Washington DC, United States	27.46
8.	DigitalGlobe	Product Manager	Colorado, United States	47.37
9.	HOT Activator	Mapping and GIS Expert	Manila, Philippines	45.53
10.	Humanitarian Organisation Two	Disaster Responder and Information Management Officer	Geneva, Switzerland	47.09
11.	OSM Contributor	Computer Scientist	Berlin, Germany	49.36
12.	OSM Contributor	Geospatial expert. Open-Source Geospatial Foundation and Prodevelop	Valencia, Spain	48.01

13.	OSM Contributor	Internet entrepreneur and cofounder of Lokku	London, UK	35.44
14.	NEDA	Economic Development Specialist	Eastern Visayas, Philippines	58.34
15.	OSM Contributor	Physicist	Los Angeles, California, United States	49.36
16.	OSM Contributor	Computer Software Professional	Bad Laer, Germany	47.31
17.	OSM Contributor	Web Designer	Rome, Italy	40.43
18.	OSM Contributor	Web Developer	Haarlem, Netherlands	55.14
19.	OSM Contributor	Researcher	London, UK	39.43
20.	Humanitarian Organisation One	Information Management Delegate	Manila, Philippines	46.23
21.	OSM Contributor	OSM Foundation Board Chairman	Kindhausen, Switzerland	63.48
22.	OSM Contributor	Master's Student (did mapping as a volunteer course)	Beijing, China	16.40
23.	OSM Contributor	Industrial Maintenance Worker	Los Angeles, California, United States	49.41
24.	OSM Contributor	Geographer, Senior Environmental Scientist	Rio De Janeiro, Brazil	86.27
25.	OSM Contributor	Canadian Military	Ottawa, Canada	36.16
26.	OSM Contributor	UX Designer, Graphic Designer	Kristiansand, Norway	65.44
27.	OSM Contributor	Digital Geographer, Investor, Visiting Lecturer	London, UK	58.56
28.	United States Agency for International Development (USAID)/OSM Contributor	Geographic Information Specialist	Washington DC, United States	42.48
29.	OSM Contributor	Finance (Non ICT background)	Delft, Netherlands	54.36
30.	HOT Director	Director	Jakarta, Indonesia	32.12

31.	Geospatial Engineer, DART (Disaster Assistance Response Team)	Canadian Armed Forces at the 1st Canadian Division HQ	Kingston, Canada	89.28
32.	Humanitarian Organisation One	GIS Officer	Washington DC, United States	44.23
33.	George Washington University	GIS and Cartography Academic/Researcher	Washington DC, United States	29.26
34.	OSM Contributor	Programmer, Geocacher	Paderborn, Germany	45.55
35.	OSM Contributor	Master's Student	Salzburg, Austria	40.09
36.	OSM Contributor	Student (Physics)	Montreal, Canada	39.59
37.	OSM Contributor	Director of IT	Portland, Oregon, United States	48.13
38.	Humanitarian Organisation Three	Geospatial Consultant	London, UK	45.00
39.	Humanitarian Organisation One	Geospatial Architect & Developer	Washington DC, United States	33.44
40.	QCRI, Digital Humanitarian Network, Standby Volunteer Task Force	Director of Social Innovation, Co-founder, Thought Leader	Doha, Qatar	22.35
41.	SBTF (The Standby Task Force)	Digital Communications Specialist	London, UK	36.00

It was important for this study to interview actors from humanitarian organisations who had used OSM crowdmaps on the ground. Contact with many of the humanitarian actors was made through the 'snowballing' technique. For example, one of the governance actors assisted in developing contact with Humanitarian Organisation One. Importantly, Pan and Tan (2011) wrote about the figure of the 'gatekeeper', an influential person who assists the researcher with introductions and important information. For this research, one contributor did play a 'gatekeeper' role. Furthermore, another important idea considered when liaising

with actors was that of 'interactional expertise' (H. Collins, 2004). Interactional expertise lays in-between embodied skill and formal propositional knowledge, and is the ability to communicate in regard to a particular expertise, without being able to practice it. Although crowdmapping through the OSM system is designed in such a way that anybody can participate, the idea of interactional expertise was considered in regard to, for example, crowdmapping technology and satellite imagery. Extensive reading and mapping was undertaken in regard to this, to hone interactional expertise.

In terms of constructing the questions, a list of open-ended questions was developed for interviews that were semi-structured in nature. Some of the interviews actually tended more towards being unstructured, usually when certain issues or matters, identified through the semi-structured interviews, needed to be explored more in-depth. For example, when the author asked one interviewee about how OSM had obtained satellite imagery from DigitalGlobe during the Haiyan activation, he was directed towards another interviewee who had more information on the matter. So, when this second participant was interviewed, the questions only involved the negotiations that had taken place to obtain satellite imagery; this helped to understand this aspect more in-depth.

The initial semi-structured questions centred upon four main areas, with different numbers of questions depending upon the actor being interviewed; OSM contributors were asked around 25 questions, while organisational actors were asked around 14; these questions were modified and added to, based on the interviewee and data collected from previous interviews. The questions directed to OSM contributors typically revolved around four main topic areas: mapping practices, technological interaction, satellite imagery, and the impact of crowdmapping. The questions for organisational actors typically revolved around the mapping process, satellite imagery, and the impact that crowdmapping had on the ground. Table 9 and 10 present the interview questions that were explored in these topic areas. Appendix 4 presents an example interview transcript.

Table 9 - Generic semi-structured interview questions for OSM contributors

Interview Questions – OSM Contributors
1) I want to begin by understanding how the map was built up? What did you and other contributors do at different stages of this building of maps?
2) Why did you decide to contribute towards the crowdmap?
3) What do you think was expected of you as a contributor?
4) How many contributions did you make to the map? Did you play any other role in the Haiyan map?
5) Did you contribute to other disasters, such as Haiti? Are the same contributors moving from disaster to disaster?
6) Did you have any volunteer experience before, during disaster situations, other than mapping?
7) Where did you originally hear about OSM?
8) I want to understand more about the OSM community. Is there any organisational structure by the OSM activators that the contributors must operate in? How did the OSM enable and constrain users?
9) Do you communicate in anyway with other OSM contributors? If yes, how? If not, why not?
10) Was there any local knowledge from Filipinos involved in any aspect whatsoever?
11) What are the technological components of OSM?
12) Did a previous technological infrastructure assist or help OSM such as Ushahidi? Ushahidi-Haiti might have given the technology to Haiyan. What generated what?
13) Were you familiar with the OSM system or did you have to be trained?
14) How are the contributions validated or accepted? What is the process? How is inappropriate action dealt with?
15) Can you recall an incident where a contribution was not accepted?
16) What role did social media such as Twitter play in the mapping process? Such as spreading the word that people could contribute?
17) How was the pre-Haiyan satellite imagery released to the OSM community by DigitalGlobe? Who did it in terms of personnel negotiation? Who took the decision? And Why? What was the expectation of releasing it?
18) Why did DigitalGlobe release the satellite images publically? Were they initially reluctant?
19) Did the OSM activation team know the Red Cross from before? Who asked who to help or contribute?
20) Which geographical areas were most contributed towards?
21) I would like to understand something more about the Philippines government response during Haiyan – how do you think they changed their response or efforts once the map usage had started to become more and more prominent, which of course highlighted areas of need? Do you think the map was influencing their decision making in any way? Such as being more helpful or resourceful than perhaps they would have been because things were more highlighted?
22) In essence, how do think that crowdmapping and the efforts by contributors all around the world helped during Typhoon Haiyan? How do you think crowdmapping is changing things?

23) What happened before the maps? What about after having the maps? What exactly did crowdmapping enable? If these things were enabled before, how so?
24) How do you think crowdmapping is changing disaster management?
25) Anything else you would like to add, that I may have missed or you think I should know about, that was significant?

Table 10 - Generic semi-structured interview questions for organisational actors

Interview Questions – Organisational Actors
1) I want to understand more about the [anonymous] using the crowdmapping in an official manner for the first time. What allowed you to do this? Why? What about trust?
2) What role did you play? What areas did you cover?
3) What made you confident specifically about the OSM team, that you could go official? Why not other crowdmapping teams or initiatives?
4) Could you elaborate on the satellite imagery and how these were obtained? Did you negotiate at all with satellite providers?
5) Why did you contact the DigitalGlobe on behalf of the OSM contributors? Could you please go into more detail in regard to the negotiations that took place?
6) How was the post-Haiyan satellite imagery released to the OSM community by DigitalGlobe? Who did it in terms of personnel negotiation? Who took the decision? And Why? What was the expectation of releasing it to OSM?
7) Why do you think DigitalGlobe released the satellite images publically? Were they initially reluctant?
8) What was the expectation of releasing the satellite imagery to OSM?
9) What are your thoughts on the repeated satellite images being released for Tacloban? Why was this the case
10) What are your thoughts on the petition that was filed by HOT asking for the quicker release of imagery?
11) How did the [anonymous] evaluate the updated maps that were given to them by the OSM community? Did you trust the map or did you have it evaluated?
12) How were the maps passed from OSM to the [anonymous]? What technology was used?
13) What role did social media such as Twitter play in the whole process? Such as spreading the word that people could contribute?
14) At the beginning, when you first received the map from OSM and deployed it, what did you think the map would enable? What actually happened? When you reflect on the whole usage of the map, how does what you initially thought the map would enable differ from what it actually resulted in?
15) Did this exceed expectations?
16) Was there any local knowledge from Filipinos involved in any aspect whatsoever?
17) Are you aware of the imagery coordination tool?
18) I would like to understand something more about the Philippines government response during Haiyan – how do you think they changed their response or efforts once the map usage had started to become more and more prominent, which of course highlighted areas of need? Do you think the map was influencing their decision making

in any way? Such as being more helpful or resourceful than perhaps they would have been because things were more highlighted?

19) Are you aware of the Philippines government using OSM in more official ways?

20) In essence, how do you think that crowdmapping and the efforts by contributors all around the world helped during Typhoon Haiyan? How do you think crowdmapping changed things during Haiyan?

21) How were things done before the maps during a natural disaster? What about after having the maps? What exactly did crowdmapping enable? If these things were enabled before, how so? Or were new things being enabled?

22) What are the new norms in disaster management based on this technology, and how is disaster management changing (stages of disaster)? How do you see things in the future? Do you think the instance of Haiyan will influence future endeavours?

Throughout the whole interviewing process, the guidelines set by scholars including Myers and Newman (2007), and Pan and Tan (2011) were consistently followed. For example, Pan and Tan (2011) stated that, as a more comprehensive picture is formed, the focus of later interviews should be different to that of early ones. Myers and Newman (2007, pp. 4-5) presented potential problems that may arise when conducting qualitative interviews—namely, the artificiality of the interview, lack of trust, lack of time, lack of entry, elite bias, Hawthorne effects, construction of knowledge, ambiguity of language, and interviews going wrong—and the ways in which these problems can be tackled—namely, the dramaturgical model. Studying these potential problems along with the dramaturgical model sensitised the researcher to the complexities of the interview process.

As the interviews were conducted over Skype, a software named Evaer was used to record the calls with the explicit agreement of the participants. The very first interview lasted for around 96 minutes, as this was when a comprehensive overall picture of crowdmapping for humanitarian response was developed. This is in line with Pan and Tan (2011) views that *“the first interview, in particular, should be with an informant who can provide an overview of the phenomenon under study. This allows the researcher to validate and, if necessary, modify his/her mental concept of the phenomenon at the earliest available opportunity”* (Pan and Tan, 2011, p. 167).

Each interview was transcribed as soon as possible after being conducted, when the discussion that had taken place was still fresh in the mind of the author. A transcription software named Express Scribe was used; this software has certain features that make a transcribing process efficient. The recordings were played at 75% speed and with an

automatic pause; this gave the author enough time to transcribe without continually having to manually stop and restart. On average, each interview took around 5-6 hours to transcribe, including the time needed to correct the transcript.

4.7.3 Collecting Online Data

In addition to the semi-structured interviews, online data was also collected from the HOT mailing list/forum and through Skype instant messaging. This followed a specific point made by Walsham (2006), that *"interviews should be supplemented by other forms of field data in an interpretive study... Web-based data from e-mails, websites or chat rooms can be very valuable"* (Walsham, 2006, p. 323).

The author signed up for the HOT mailing list which would typically result in emails being sent to the author with a frequency ranging from once to thrice per day. Previous mailing list posts could also be accessed online through the archives section of the HOT website, also referred to as the forum. Archival mailing list data was explored closely for the Haiyan response; the Haiyan response resulted in considerable activity through the mailing list. This data typically involved discussions between actors from the HOT community, humanitarian organisations and technology providers. Examples of the discussions centred on imagery requests made by the HOT community, mapping requests made by humanitarian organisations based on their usage of the maps the ground, and information on imagery availability provided by technology providers; the online petition, which is explored later in the study, was something that was discussed through the mailing list, as was how the building damage data was used by humanitarian organisations. In total, 504 messages were exchanged; 330 messages in November 2013, and 174 messages in December 2013, between these actors. The collecting of archival mailing list data took place mainly in August 2014 and carried on intermittently until October 2014. Appendix 2 presents examples of the subjects that were discussed in response to Haiyan through the mailing list in November 2013, presented verbatim. A range of topics were explored including mapping needs, satellite imagery and the online petition.

Skype instant messaging data was also collected and reviewed. This included further instant messaging conversation with those with whom the semi-structured interviews were conducted with. This data added to the richness of primary data collection. An example included further communication over instant messaging with a HOT Activator regarding the

release of the OSM damage assessment report conducted by the REACH Initiative and the American Red Cross. Aspects of the report were explored in-depth through the medium of Skype instant messaging. Moreover, actors from Humanitarian Organisation One were intermittently conversed with regarding the usage of OSM crowdmaps on the ground. In essence, the collecting of Skype instant messaging data took place in August and September 2014 and typically involved intermittent instant messaging discussions. The author was alerted to the importance of Skype instant messaging data, due to its regular use in the humanitarian context. For example, during Haiti, Ushahidi founder Patrick Meier stated that *“Skype chats played an invaluable role in the disaster response to Haiti but this has gone largely unnoticed by both mainstream and citizen media”* (Meier, 2010). Appendix 3 presents an extract from a conversation with a HOT Activator in regard to the benefits of UAV/drone imagery for the crowdmapping process.

Table 11 presents a breakdown of the data sources of this study, the period of collection for each source, and the number of unique participants/messages.

Table 11 - Details of Data sources and collection

<u>Data Sources</u>	<u>Period of Collection</u>	<u>Number of Unique Participants/Messages</u>
Semi-structured interviews	August 2014 – July 2015	41 participants (43 interviews)
Email communication	July 2014 – November 2015	9 participants
HOT mailing list/forum	August 2014 – October 2014 (Archival content - 330 messages in November 2013, and 174 messages in December 2013)	504 messages
Skype instant messaging	August 2014 – September 2014	4 participants

4.8 Data Coding and Analysis

Each interview was transcribed verbatim and read carefully soon after conducting it. Once an initial set of interviews had been conducted, a descriptive coding process was undertaken, followed by the identification of themes. By the end of data collection, 91 descriptive codes were developed. These codes were then grouped into themes. These themes resonated well with concepts from structuration theory. A full list of the initial descriptive codes is presented in appendix 5. Appendix 6 details the analytical themes from the data mapped to concepts of

structuration theory. Moreover, appendix 6 details the corresponding section of the analysis chapter, and presents examples from the data.

The descriptive coding process was undertaken manually using Microsoft Word. Although there is various software, such as Nvivo, that can aid coding, this study did not use any. Instead, through Microsoft Word, headings for the identified descriptive codes were created in a Word document, and the relevant pieces of data from the interviews were added to their corresponding codes. The descriptive coding process was repeated to ensure the fit between the data and codes.

With regard to the understanding of action or practices, it was important to undertake a somewhat fine-grained comprehension of processes through deep and prolonged engagement; only thus was it possible to understand the intricateness of practices and how these may impact events e.g. the online petition and the practices of the relevant actors (OSM contributors, HOT activators and Humanitarian Organisation One) in regard to it were explored in depth, which allowed for an understanding on the role of the petition in challenging the domination over resources. Moreover, various collection sources were used as aforementioned. As the main objective of this study was to understand whether the practices of crowdmapping impact humanitarian response and, if so, how and why, two separate files were developed; the first corresponding to the OSM contributors and the second to the organisational actors that had been interviewed. This served the purpose of more easily separating action and impact; the OSM contributor file detailed the agency exercised by OSM contributors, whilst the organisational actors file emphasised the impact of and change resulting from such exercised agency. Both files were able to be connected through the identified key events such as the online petition, testing of UAV/drone imagery, mapathons, and also through the exploration of how the crowdmaps were being used by Humanitarian Organisation One.

In essence, all 43 interviews and collected online data were fully coded and sorted into themes. The themes were then mapped to structural concepts with which they resonated with, as presented in table 6, and elaborated upon in appendix 5 and 6.

4.9 Evaluation of Research

This section details an evaluation of this study, based on the guidelines presented by IS scholars for the undertaking of qualitative interpretivist research. Table 12 presents the principles of guidance for qualitative research identified by Sarker et al. (2013)—namely, variety, internal coherence, relevance, theoretical engagement, transparency, self-criticality, and dignity—and the demonstration of the principle with regard to this study.

Table 12 - Principles for interpretivist research, adapted from Sarker et al. (2013)

<u>Concept from Sarker et al. (2013)</u>	<u>Demonstration of principle from this study</u>
Variety	The study is clear in placing the research in a specific tradition—namely, qualitative interpretivist research—and in the IS crowdsourcing literature. This decision is presented after illustrating the differences between the various philosophical paradigms and selecting the one consistent with the author’s world view.
Internal coherence	The study strives for a high level of coherence in its anatomical elements. Sections are clearly labelled and care is taken to make each section flow well. The analysis is presented in a clear and defined manner, according to the theoretical foundation.
Relevance	The study explores crowdsourcing, a sociotechnical phenomenon; therefore, the role played by IT is significant. The chosen methodology is an interpretivist case study with data primarily collected through semi-structured interviews. Questions were tailored according to each interviewee, which is consistent with the interview recommendations made by Walsham (2006), and Myers and Newman (2007). The analysis was started during the data collection, enabling the further refinement of the questions. The time period and length of interviews is articulated. A detailed case description is presented before offering an interpretation, which is consistent with the recommendations made by Eisenhardt and Graebner (2007). Practical recommendations are made based on the analysis.
Theoretical engagement	Theoretical engagement is enacted by interpreting crowdmapping for humanitarian response through the lens of structuration theory. The theory is used up-front to conceptualise and make sense of the data. The importance of theoretical engagement is articulated—e.g., the crowdsourcing phenomenon has largely remained ‘atheoretical’. The theoretical engagement is also consistent with Walsham’s (2006) recommendation of justifying the use of theory—e.g., reasons are provided for using structuration theory, such as the theory addressing and explaining change and therefore lending itself well to the exploration of the problem at hand.
Transparency	The analysis or interpretation of data is based on structural concepts. This links the second half of the study with the first, to

	make it flow well. Figures are presented throughout to provide interpretivist visualisations. Quotes are presented throughout to add richness to interpretation, and to give the ‘feeling of being there’, as elucidated by scholars including Eisenhardt and Graebner (2007). Issues such as temporality (timeline), tensions and change are considered, as elucidated by Langley et al. (2013). Accountability and auditability guidelines are adhered to; it is made very clear as to where, when, how and from whom the data were collected, and how they were analysed and inferences made.
Self-criticality	The data were analysed iteratively and according to a timeline. Throughout the study, the author kept a questioning attitude in regard to data, data sources and analytical tactics. The interpretation of the case description was never accepted as being final, and constant iterations between data and theory were made. This attitude of self-criticality also led the author, for example, to interview multiple actors at different stages of the crowdmapping process.
Dignity	Throughout the study, the author kept an attitude of dignity in regard to qualitative research.

4.10 Ethical Issues

Various ethical issues had to be taken into consideration in this research. In essence, the ethical guidelines stipulated by Myers and Newman (2007, p. 23) were followed. These are as follows:

- *Permissions* – initial ethical approval was obtained through the ethical committee at Royal Holloway, University of London. Also, permission was obtained from the interviewees, who were given a clear explanation of the study and of why their participation was sought. At the beginning of each call, it was made clear that it would be recorded, and the interviewees were asked whether they approved of this.
- *Respect* – The interviewees were treated with the utmost respect at all stages before, during, and after the interview. Their knowledge was given full respect, as were their time and the roles that they played in the overall scheme of things.
- *Fulfilling commitments to individuals and organisations* – The utmost confidence was maintained between author and participant. Transcripts and recordings were kept confidential and secure, and findings were shared with participants before the final version was decided upon. Amongst other reasons, this ensured that the factual information was correct.

Further ethical considerations made by Walsham (2006) were also pondered over, including confidentiality and anonymity, working with the organisation, and reporting in the literature.

4.11 Summary of Chapter

In summary, this chapter presents the study's research methodology, beginning with the researcher's philosophical assumptions in undertaking the research, which is an interpretive stance. It then details the methods undertaken—namely, a case study with semi-structured interviews—and how these prove insightful in exploring the research's aims and objectives. Furthermore, detail is provided on data collection and analysis. The next chapter presents the aforementioned case study; crowdmapping in the context of humanitarian response.

Chapter Five: Case Study

5.1 Introduction

This case study presents the development of crowdmapping in the context of humanitarian response. It traces the development of crowdmapping from 2009 to 2015 and describes the various developments and changes that have taken place in this period of time. It is useful to begin with the 2010 Haitian earthquake as the first major response, as this represents the disaster which saw the rise of crowdsourcing and, in particular, crowdmapping to increasing prominence (Linden, 2013). As argued by Giroux et al. (2013), crowdmapping's *"breakthrough came during the Haitian earthquake in 2010"* (Giroux et al., 2013, p. 7). Since Haiti, humanitarian response has changed over a relatively short period of time and, in 2011, it was argued that the humanitarian model's *"origins are firmly rooted in the analogue age, and there is a major shift coming"* (Conneally, 2011). Along with many other digital humanitarians, Conneally (2011) identified the 2010 Haiti earthquake as being the catalyst for this major shift or change (K. Collins, 2013). This change can also be observed, for example, in the difference in the numbers of crowdmapping contributors for the OSM responses to the 2010 Haiti earthquake and the 2013 Haiyan typhoon; the Haiti earthquake involved over 600 contributors, whilst Typhoon Haiyan saw over 1,400 (HOT, n.d-b). This is just one small example of how crowdsourcing and, in particular, crowdmapping has started to become increasingly prominent in the context of humanitarian response.

To understand how crowdmapping has evolved from Haiti to Haiyan and beyond, this case study describes, in chronological order, the major developments that have taken place since the Haiti response. By highlighting the emergence of crowdmapping, the second section sets the scene for its role in the context of humanitarian response. The third section explores the Haiti response by looking at the crowdmapping technologies that were employed. The fourth section examines a major phenomenon that has occurred since Haiti—namely, the rise of digital humanitarian organisations. The fifth section explores other major crowdmapping responses that have taken place since Haiti—namely, the 2011 Libya and Japanese responses; although there have been many others, these two are described as, for reasons which are explored, they can be considered pivotal. The sixth section explores the technological advances related to crowdmapping. The seventh section moves on to the Haiyan response, and explores the different crowdmapping technologies that were employed. The eighth

section explicates the advances in partnerships and agreements between actors that have come into being since Haiti. The ninth and final section, presents the summary of the chapter.

5.2 The Emergence of Crowdmapping

Table 13 details the major events and crowdmapping activations that are explored, in chronological order, in the case study.

Table 13 - Chronological order of major crowdmapping events and activations between 2009 and 2015

<u>Year</u>	<u>Major Events/ Crowdmapping Activations</u>	<u>Description</u>	<u>Technologies Used</u>
2009	International Conference on Crisis Mapping (ICCM)	Pivotal conference recognising the need for crowdmapping for humanitarian response. The conference brought together representatives from various governments and humanitarian organisations such as the UN and the Red Cross.	
	Formation of the International Network of Crisis Mappers (Crisis Mappers Network)	The Crisis Mappers Network consists of practitioners, policymakers, technologists, experts, researchers, journalists, scholars, hackers and skilled contributors involved in crowdsourcing, crisis mapping and new technologies. With over 7,500 members engaging from over 160 countries, the network claims to be the most active and largest community of its kind.	
2010	Haiti Response	The disaster regarded by many as having seen the breakthrough for crowdmapping in the context of humanitarian response.	-Ushahidi -OSM
	Formation of HOT	HOT acts as the bridge or link between the OSM community and traditional humanitarian organisations and responders.	
	Formation of SBTF	SBTF centres on organising digital contributors in an organised and skilled fashion to assist disaster affected communities.	
2011	Libya Response	Another important response that brought about the realisation that advanced computing technologies would have to be developed to take some of the burden off digital humanitarians.	-SBTF Crisis Map -OSM
	Japanese Response	The response that highlighted that crowdmapping could also be largely	-SBTF Crisis Map -OSM (Sinsai.info)

		beneficial in developed countries and not only in developing ones.	
2012	Formation of the Digital Humanitarian Network (DHNetwork)	A network of networks that links contributor and technical communities whilst providing an interface for communication between formal, professional humanitarian and contributor groups.	
2013	Haiyan Response	The response that brought a much wider acceptance and acknowledgement of crowdmapping, not only from humanitarian organisations, but also from the mainstream media and society.	-OSM -MicroMappers -SBTF Crisis Map -Google Crisis Map
2014	Hagupit Response	The response in which many of the lessons learned from previous activations, such as attempts to democratise imagery procurement, were put into practice, therefore highlighting the improvements in partnerships and agreements.	-OSM -MicroMappers -SBTF Crisis Map
2015	Nepal Response	In a similar manner to the Hagupit response scenario, many of the lessons learned from previous activations were put into action.	-OSM -MicroMappers -SBTF Crisis Map

In order to become aware of the details, including roads and infrastructure, that enable them to efficiently navigate relief efforts, humanitarian organisations require complete maps; otherwise, regardless of the levels of resources or manpower they may have on the ground, humanitarian organisations will not know where to direct them. The use of the crowd to populate maps provides humanitarian organisations with actionable ones in a timely fashion; simple mathematics show that, should 1,000 crowdsourced contributors work on populating a map, their efforts would far exceed, in terms of time and cost, those made to the same end by just a few individuals. Looking at Haiti after the earthquake, for example, it can be seen that a base layer map proved particularly vital for a number of reasons. Much of the existing physical, social, and political infrastructure, that was minimal even before the earthquake, was damaged or destroyed. This meant that humanitarian organisations had to face challenges, such as determining what areas needed assistance and how to get to them, without critically important up-to-date base maps; the absence of comprehensive maps can thus result in wasted and misdirected efforts, and, in the worst case scenarios, lost lives.

The roots of crowdmapping in humanitarian response can be traced back to before Haiti. Recognising its effectiveness in different contexts, such as mapping crime, and its potential importance in humanitarian response, Patrick Meier and Jen Ziemke arranged a meeting of a number of actors, including academics and practitioners, to ponder and explore the idea of crowdmapping in the latter scenario; in other words, crisis mapping. Their deliberations culminated in the first ICCM Conference, held in 2009, which included representatives from various governments and organisations, including the UN. As was argued by Crowley (2013), *“this meeting came at a pivotal moment. The relationships and ideas created a buzz throughout the late fall of 2009”* (Crowley, 2013, p. 29).

When the Haiti earthquake struck and the various humanitarian organisations were seeking actionable and complete maps by which to plan their response, the Crisis Mappers Network managed to pool a number of actors into one place, cutting across traditional institutional boundaries, thus enhancing the effectiveness of the response. The Crisis Mappers Network acted as a bridge between formal humanitarian organisations and contributor ones. The need to keep up with the intensity and tempo of participated activations during this period also sparked the evolution of the organisational structures of many digital humanitarian organisations (Crowley, 2013). The ICCM Conference, now held on a yearly basis, brings together the global crisis mapping community to discuss the lessons learned from the previous year’s activations, build relationships, discuss challenges and future deployments, and present best practices, innovations and deployments. As articulated by Patrick Meier, *“the annual CrisisMappers conference is the leading international event dedicated to advancing the study and practice of humanitarian technology worldwide. We believe that sharing best practices and lessons learned across organizations and multiple areas of expertise catalyzes the partnerships necessary to develop next-generation humanitarian technology solutions that save lives”* (Leson, 2012). The conference was held in Cleveland, Ohio, in 2009; in Boston, Massachusetts, in 2010; in Geneva, Switzerland, in 2011; in Washington, D.C., in 2012; in Nairobi, Kenya, in 2013; and in New York, New York, in 2014.

5.3 Haiti

The 2010 Haiti disaster was the result of a catastrophic 7.0 magnitude earthquake that struck on the 12th of January of that year. The devastation resulted in the deaths of hundreds of thousands of people, with some estimates placing the figure at around 316,000. Picture 1

shows how the earthquake caused major devastation to roads, infrastructure and personal property.



Picture 1 - Haiti devastation (news.bbc.co.uk, 2010)

Picture 2 shows further damage and the pleas for help of those affected.



Picture 2 - Haiti calls for help (Conneally, 2011)

The following sections present the crowdmapping technologies employed during the Haiti response—namely, Ushahidi and OSM.

5.3.1 Ushahidi

Ushahidi is a non-profit open-source software organisation that develops web tools to help actors respond to crises, be they political upheavals or natural disasters. The Ushahidi crowdmapping tool allows the collection of field reports from a number of sources, including social media, SMS, and web postings, to be displayed in aggregate form on a crowdmap; the Ushahidi crowdmapping tool has been praised for “*providing critical and often life-saving data during emergencies*” (MITtechnologyreview, n.d). The tool was originally developed to

monitor violent outbreaks and electoral fraud in response to the disputed 2007 Kenyan election. Ushahidi relies on donations from philanthropic organisations and rejects any coming from government channels. In terms of the Haiti response, a few hours after the disaster had struck, on the 12th of January, Patrick Meier and David Kobia developed the Ushahidi map of Haiti, which included information from a number of different sources, including Facebook, Twitter, and the mainstream media. However, the information that was being mapped came mainly from tweets. After a short time, the quantity of incoming information to be mapped became so vast that Patrick and David realised that they would need assistance to keep abreast of the influx. Overall, over 3,000 information reports were crowdmapped, and various testimonials confirmed the effectiveness of the Ushahidi crowdmap; Chris Fugate, head of the Federal Emergency Management Agency (FEMA), stated in a tweet that *“the crisis map of Haiti represents the most comprehensive and up-to-date map available to the humanitarian community”* (Heinzelman and Waters, 2010, p. 9).

5.3.2 OSM

Another equally important initiative born in the aftermath of the Haiti earthquake was the development of the OSM Haiti crowdmap. OSM is a collaborative and collective initiative that enables users to edit maps of the world. The project was developed in 2004 by Steve Coast, at the University College London, and was inspired by the Wikipedia model. It has developed a user base of over 1.6 million contributors who utilise a variety of methods to collect data and develop maps; this includes data obtained through manual surveys and from satellite images and GPS devices (Neis and Zipf, 2012). Whereas Ushahidi adds crowdsourced data to a base layer map, OSM strives to develop a comprehensive base layer map; this proved to be paramount in the case of Haiti, as the Google maps for Haiti and, in particular, Port-au-Prince were inadequate and incomplete.

To deal with the lack of detailed base maps, OSM Haiti developed a highly comprehensive one of Port-au-Prince through 640 contributors tracing satellite imagery, using mostly Yahoo imagery and looking over old Central Intelligence Authority (CIA) maps; further satellite imagery was released by the United States based commercial organisations DigitalGlobe and GeoEye (In 2013, GeoEye was merged into the DigitalGlobe corporation) (Maron, 2010a). In total, 1.2 million edits were made to the crowdmap. Figures 6 and 7 depict the contributions made by OSM contributors. Whilst figure 6 shows the map with no contributions, figure 7

shows the results of the OSM crowdmapping efforts. Each white flash details areas of the map that were edited. The green and red lines represent the primary and secondary roads, which were added before the smaller residential ones. Finally, the blue dots represent the spots where internally displaced people emerged.

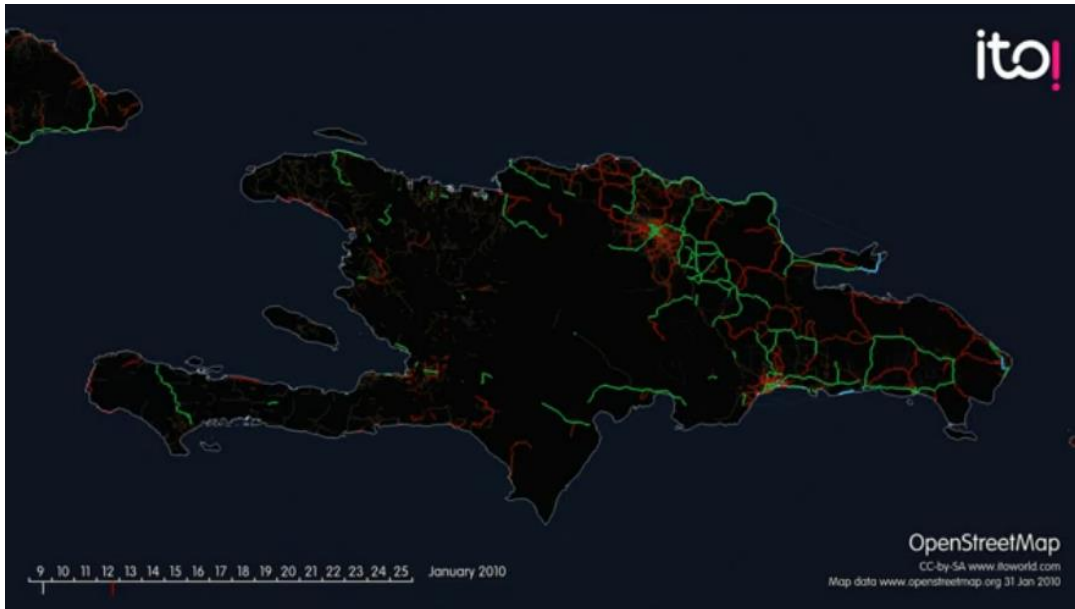


Figure 6 - OSM contributions before the crowdsourcing initiative (itoworld, 2010)

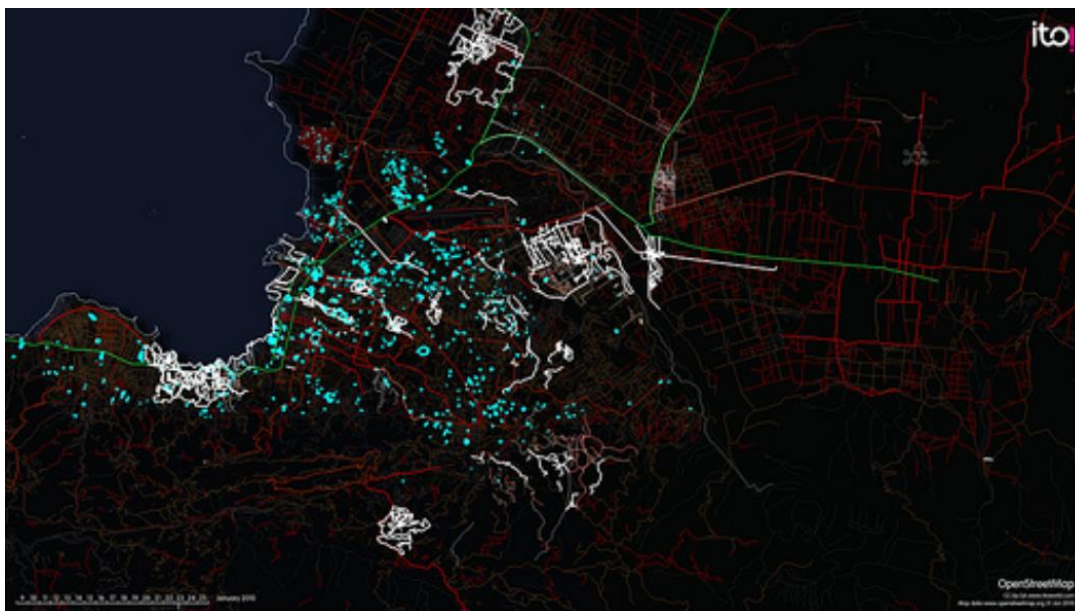


Figure 7 - OSM contributions after the crowdsourcing initiative (itoworld, 2010)

Upon comparing the completeness of the OSM Haiti crowdmap against the Google one, the Ushahidi team switched to using OSM's as the base layer map on which to add incoming

crowdsourced data; this move established a merging of efforts between Ushahidi and OSM (Bailard et al., 2012; Crowley, 2013; HOT, n.d-b). Such was the completeness of the OSM Haiti crowdmap that, before long, it became the de-facto map used by many humanitarian organisations involved in the response, recovery and reconstruction (Soden, 2014). Figures 8 and 9 depict the changing nature of the OSM Haiti crowdmaps on the same area. Figure 8 clearly shows a map area without and with limited infrastructure and roads, whilst figure 9 shows the same area increasingly and extensively populated with infrastructure, roads and other important information.

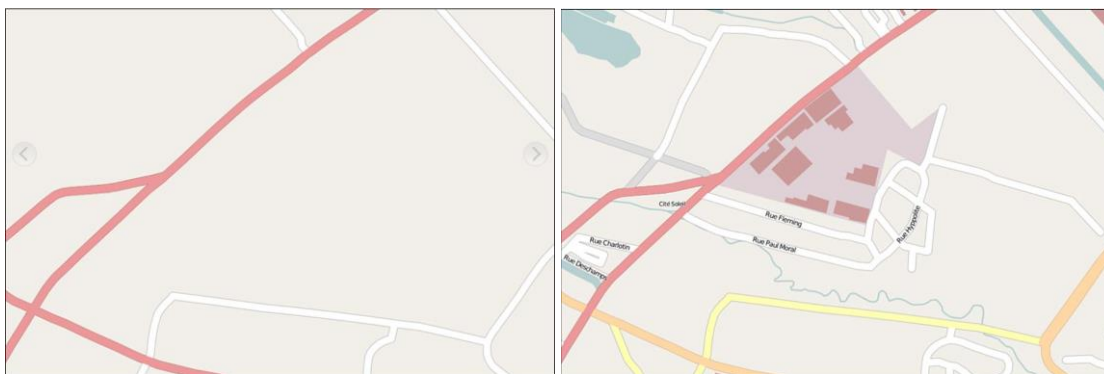


Figure 8 - OSM Haiti Crowdmap before and during the initial stages of the crowdsourcing initiative (news.bbc.co.uk, 2010)

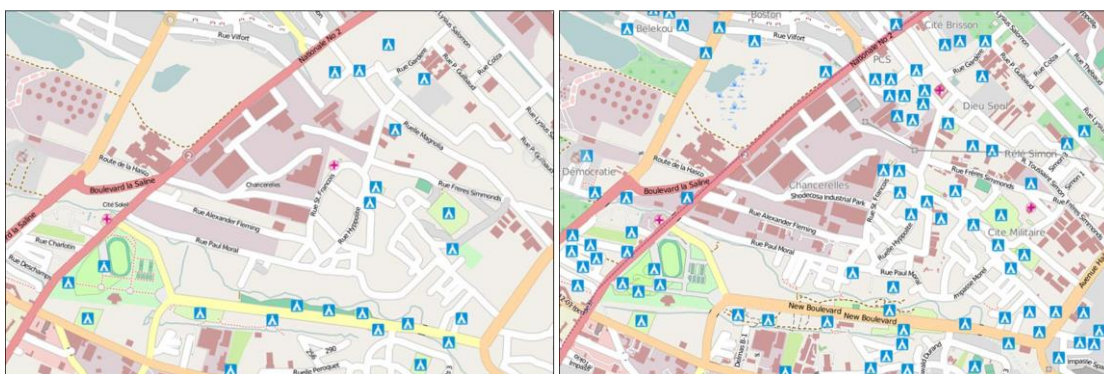


Figure 9 - OSM Haiti Crowdmap towards the end of and after the crowdsourcing initiative (news.bbc.co.uk, 2010)

All in all, the various crowdsourced initiatives launched during Haiti resulted in a crowdmap that “depicted the levels of damage, areas in urgent need of help, as well the location of important resources such as emergency shelters” (Giroux et al., 2013, p. 8). Furthermore, “reports about trapped persons, medical emergencies, and specific needs, such as food, water, and shelter, were received and plotted on maps that were updated in real time by an international group of volunteers” (Heinzelman and Waters, 2010, p. 1).

Speaking about the Haiti crowdmapping, Patrick Meier stated that OSM had developed “*the most detailed roadmap of Haiti ever produced*” (McKenzie, 2014). Articulating the practical uses of the OSM crowdmap and the impact that crowdmapping was having on the ground, Kjeld Jensen of the Red Cross assured that “*I just wanted to let you know that your work on improving the Haiti maps is really appreciated here. A few days ago, I installed a version on my Garmin Oregon GPS and the result is impressive. It has already saved me and my driver from getting lost twice, and the alternative would have been long delays. In the coming days I will try to update our Red Cross relief GPS receivers with your map*” (OpenStreetMap, 2010).

He further stated that “*I wish there was a way that I can express to you properly how important your OSM files were to us. Having these detailed maps on our GPS units is a big deal. Shortly after discovering your work I quickly spread the word and transferred the street level maps onto as many Garmin units as we could before sending the American rescue teams on the streets. The team members are thrilled to have this resource you have created. I wish you could see their faces 'light up' when I take their GPS unit and tell them that I'm going to give them street level detail maps. They have been working VERY hard and anything that can help them in every aspect of their mission here is greatly appreciated. I am spreading the word about this work to all rescue and humanitarian teams on the ground here in Haiti. Please be assured that we are using your data - I just wish we knew about this earlier. THANK YOU!*” (Osborne, 2010). This Red Cross testimony points at how crowdmapping began its rise in the aftermath of the Haiti earthquake. Picture 3 shows how OSM used by the Red Cross on its mobile GPS devices during the Haiti response.



Picture 3 - Red Cross using OSM during Haiti response (news.bbc.co.uk, 2010)

In essence, highlighting the effectiveness of crowdmapping during Haiti, Secretary of State Hillary Clinton noted that *“information networks have also played a critical role on the ground. When I was with President Preval in Port-au-Prince on Saturday, one of his top priorities was to try to get communication up and going. The government couldn’t talk to each other, what was left of it, and NGOs, our civilian leadership, our military leadership were severely impacted. The technology community has set up interactive maps to help us identify needs and target resources. And on Monday, a seven-year-old girl and two women were pulled from the rubble of a collapsed supermarket by an American search-and-rescue team after they sent a text message calling for help. Now, these examples are manifestations of a much broader phenomenon. The spread of information networks is forming a new nervous system for our planet. When something happens in Haiti or Hunan, the rest of us learn about it in real time – from real people. And we can respond in real time as well”* (Clinton, 2010).

5.4. The Emergence of Digital Humanitarian Organisations (DHOs)

Since Haiti, a number of DHOs have emerged and developed to be able to further leverage the crowd for humanitarian response in a more organised manner. The DHOs presented in this section include the Crisis Mappers Network, HOT, SBTF and the DHNetwork. A DHO can be defined as a *“grassroots organization that mobilizes a large number of individuals that share a set of open tools, practices, and ethical standards to create a collective intelligence for*

providing information as aid” (Crowley, 2013, p. 28). DHOs rely on four core elements that enable them to effectively achieve their objectives. Communities – DHOs have the abilities and skills needed to harness and utilise the crowd through the goodwill and reputation they have built up over a period of time. Technologies – DHOs possess various software and hardware capabilities that enable them to achieve objectives in an effective and efficient fashion. Practices – Best practices are developed and worked upon so that information can be successfully delivered, where information acts as a form of ‘aid’. Ethics – Shared values are promoted so that the crowd can unite under them (Crowley, 2013).

5.4.1 The Crisis Mappers Network

The Crisis Mappers Network was launched at the 2009 ICCM Conference, held in Cleveland, Ohio. This network consists of practitioners, policymakers, technologists, experts, researchers, journalists, scholars, hackers and skilled contributors involved in crowdsourcing, crisis mapping and new technologies. It claims to be the ‘most active’ and ‘largest’ community of its kind, with over 7,500 members engaging from over 160 countries. Crisis Mappers Network is affiliated with over 3,000 different institutions and over 400 universities. Further affiliations are with 50 UN projects and agencies, technological organisations, first responders for military and civilian organisations, digital humanitarian organisations, and humanitarian organisations (crisismappers.net, n.d). Originally launched by 100 individuals, the crisismapper.net site has been accessed in over 191 countries, acknowledging its role as a hub for crisis mapping.

The network’s purpose is to advance, both theoretically and practically, the field of crisis mapping whilst promoting collaboration and coordination amongst the wide variety of actors involved. The network was co-founded by Patrick Meier and Jen Ziemke; when initially planning the first ICCM Conference, in 2009, they had estimated that only 15 people would attend but, in actuality, 100 did, highlighting the recognition of and need for crisis mapping. Furthermore, the conference was intended to be a one-time event, but eventually developed into an annual one to meet the demands of the crisis mapping community. Highlighting the effectiveness of the network, Jen Ziemke commented that *“the network is thriving because it involves different people who normally don’t get the chance to speak to one another”* (Walsh, n.d). This is despite the institutional differences that exist between the attending actors, which include humanitarian organisations, human rights workers, scholars from Non-

Governmental Organisations (NGOs), and military representatives. In essence, as further highlighted by Jen, *“crisis mapping has grown because of its own demand. There was a need for a cross-cutting horizontal network that could mitigate some of the siloing problems that exist during disasters”* (Walsh, n.d).

5.4.2 HOT

HOT acts as a bridge or link between the OSM community and traditional humanitarian organisations and responders. HOT operates on the philosophy that free geo-data is invaluable in humanitarian responses, be they to natural disasters or political crises. HOT operates both physically and remotely in countries of concern to assist in the collection, implementation, and use of complete geographical data, and to train others on using OSM. HOT also aims at helping in areas that are disaster prone by assisting with aspects of preparedness (HOT, n.d-a).

HOT's main activities include collecting data and teaching quality assurance pertaining to them, coordinating the design of OSM tools and documentation, collaborating with imagery providers and OSM outreach (HOT, n.d-c). With regard to collecting data, the HOT community, through tracing imagery, collects vector data¹, which is determined for quality, compatibility and usefulness through a verification process, in accordance with the OSM licence. Validation tools such as OSMKeepRight enable HOT to train contributors to map to a high standard with tagging schemes based on existing OSM standards agreed by consensus; this is further negotiated with humanitarian organisations to ensure that compatible tagged data are created. In order to create self-sufficient contributors and communities, HOT provides training documentation on the mapping process and tools (e.g., mapping editors). In regard to collaborating with imagery providers, HOT regularly negotiates and corresponds with imagery providers to ensure that adequate imagery is available to contributors in the mapping process.

With regard to outreach activities, HOT regularly participates in international events and conferences to explicate and promote the importance of open data tools, whilst also sharing lessons from past activations and exploring avenues to deal with future challenges. In

¹ Vector data is a way in which geographic data can be delivered to a browser or client application in small chunks. The data are represented in vector form (OpenStreetMap, 2014).

essence, as articulated on the HOT website, during an activation, HOT strives to “develop, utilize, and rely on open data • To collect data in a quick and efficient manner • To aid in the collection of mapping data for humanitarian responders • To respect local knowledge and culture • To collaborate and partner with other organizations” (HOT, n.d-c). Table 14 details the activations in which HOT has been involved since its inception. As can be seen, these have taken place in many different geographical locations, depending on where a humanitarian response was needed. Notable activations have included the Haiti and Haiyan responses; as mentioned in the corresponding sections of this case study, humanitarian organisations have testified to the crucial and important role played by HOT in supporting their response in those instances. The Haiyan section explores the significant role played by HOT in regard to that response.

Table 14 - HOT activations (HOT, n.d-d)

Year	Activation
2009	Philippines - Ondoy
	Iran -- Post-Election Crisis
	Gaza
2010	Haitian Earthquake
	Albanian Flooding Crisis Camp
	Pakistan Floods
	Alagoas Flooding
	Yushu Earthquake
	Chile Earthquake
	Storm Megi/Juan
	Colombia Floods
	Shkoder Flooding
	Cyclone Tomas over Wallis and Futuna
	2011
Libya Crisis	
Christchurch Earthquake	
Rio de Janeiro Flooding	
Richelieu River Flooding	
Horn of Africa Famine	
Samoa Cyclone Simulation	
2012	Senegal Flooding
	Refugee Camps in Ethiopia and Kenya
	Ivory Coast
	South and North-Kivu, DR Congo
	Mali Crisis
2013	Uttarakhand, India
	Typhoon Haiyan

	Tharparkar Drought, Pakistan
	South Sudan Crisis
	Central Africa Republic Crisis
2014	Democratic Republic of Congo Ebola Response
	West Africa Ebola Response
	Typhoon Hagupit
2015	Nepal earthquake

5.4.3 SBTF

In the aftermath of the Haiti response, many humanitarians speculated as to whether future responses would be as popular. Questions were asked and concern was raised to understand whether Haiti represented a one off or a new developing trend in humanitarian response. To ensure that it was the latter and to provide a higher degree of organisation in the recruiting and training of digital humanitarians, ICCM 2010 saw the launch of SBTF (Walsh, n.d). SBTF centres on training and organising digital contributors to assist disaster affected communities, thus streamlining crisis mapping digital contributor support; SBTF was put into practice in the aftermath of the natural disasters that affected, among others, Haiti, Chile and Pakistan.

In essence, it was realised that there was the need for a platform to harness and streamline digital support and for a dedicated interface for humanitarians (Meier, 2011c; StandbyTaskForce, n.d). SBTF has proved beneficial to humanitarian response and has served as the catalyst for further technological developments related to it. For example, SBTF response to the 2011 Libya crisis brought about the realisation that not only was it important to have a number of digital humanitarians in place to respond, but also that the technology had to be in place to assist them, as placing too big a burden on digital humanitarians was not overly productive; the Libya response is looked at in more detail in section 5.5, other major responses that took place after Haiti. Again, as with HOT, humanitarian organisations, including various UN agencies, have acknowledged the positive role played by SBTF in responding. MicroMappers is a technological tool developed by SBTF; it is discussed in section 5.6, relating to technology, while its practice is explored in the one about the Haiyan response, section 5.7. Other technological developments brought about by SBTF include Verily, which utilises the crowd to verify information, and Artificial Intelligence for Disaster Response (AIDR), which utilises machine learning techniques to recognise informative content on

Twitter; both are discussed in section 5.6, relating to technology. Figure 10 depicts the technological developments instigated by SBTF.

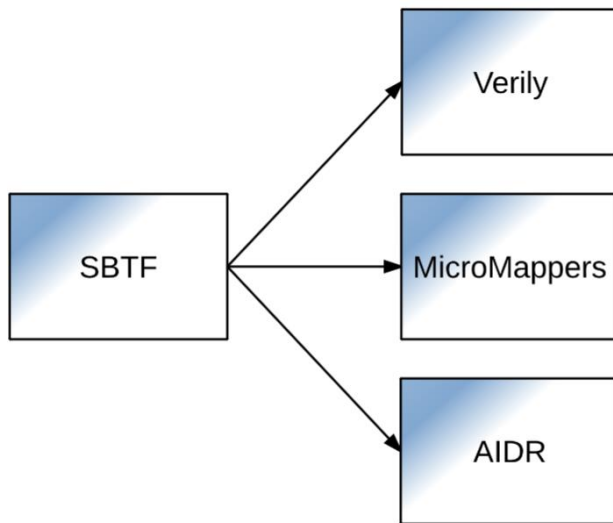


Figure 10 - Technological developments instigated by SBTF

5.4.4 The DHNetwork

The DHNetwork, co-founded by Patrick Meier and Andrej Verity, aims at supporting 21st century humanitarian response by utilising and leveraging digital networks. Launched in 2012, the DHNetwork consortium enables networking between contributor and technical communities, whilst providing a communication interface between formal, professional humanitarian and contributor groups. Members of the DHNetwork include HOTA, SBTF, GIS providers, including ESRI and GISCorps, and various UN agencies (DHN, 2014).

Figure 11 illustrates the bridging role played by the DHNetwork. On one side are the formal humanitarian responders, which include governments and humanitarian organisations such as UN agencies, Save the Children, etc.; on the other side are the volunteer and technical communities (V&TCs) or, in other words, DHOs. These V&TCs, examples of which include HOTA and MapAction, serve the purpose of providing formal humanitarian responders with various kinds of support, which include crisis mapping, geo-tagging and data mining, amongst many others. The DHNetwork acts as a bridge between the two sides, making them reciprocally more visible. The activation process is clearly defined: the formal humanitarian responders

submit an activation request to the DHNetwork; the network, in turn, assists them by putting together a solution team formed by the V&TCs best suited to satisfy the requirements.

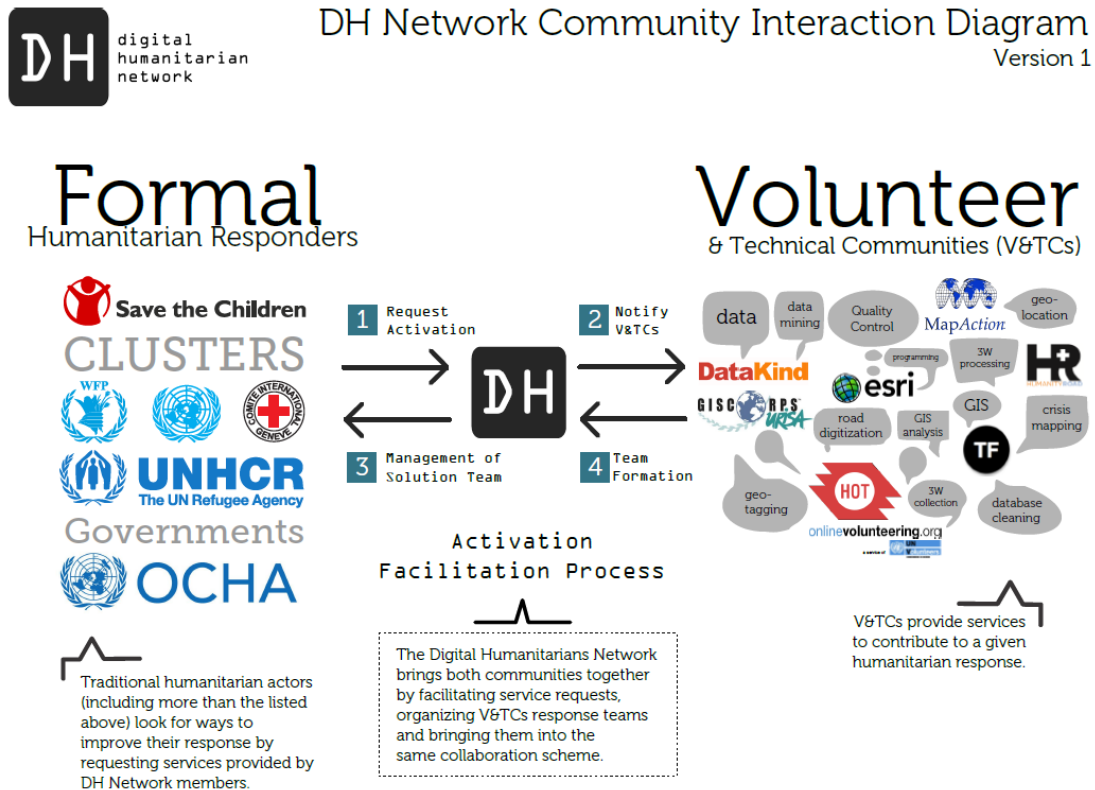


Figure 11 - DHNetwork community interaction diagram (DHN, n.d-a)

The DHNetwork has been credited with creating inroads in digital humanitarian response by enabling formal responders to leverage VT&Cs; therefore, representing, in essence, a leverage technology for humanitarian response. The DHNetwork has been activated by a number of formal humanitarian responders, including UN OCHA South Sudan, ACAPS, UN OCHA Philippines, the Samoan government, United Nations High Commissioner for Refugees (UN HCR) Syria and the UN OCHA in response to the Ebola crisis (DHN, 2014, n.d-b).

5.5 Other Major Responses after Haiti

This section explores the crowdmapping initiatives that have taken place after Haiti, particularly focussing on the responses in Libya and Japan, and why they were important to the overall evolvement of crowdmapping in the context of humanitarian response.

5.5.1 The Libya Response

The unfolding 2011 humanitarian crisis in Libya prompted the Information Services Section (ISS) and the UN OCHA to reach out to SBTF, so that the ISS could better understand how to plan its humanitarian response; they argued that they could not trust the information that was being provided by the then ruling regime. Some of the questions that needed answering included where the refugees were heading to, and from where the food and water requests were coming. Contributors searched the internet for news and information that could help the humanitarian response. This was a pivotal moment as, in essence, the crowdmapping efforts that took place were independent of the Libyan government. The humanitarian organisations turned away from the government of the geographical area that they proposed to map, and instead enrolled the help of DHOs and digital humanitarians. The Libyan government may well not have wanted to share any information that might potentially have cast it in a bad light or highlighted the desperate humanitarian situation in the country, but this had no effect whatsoever on the mapping, as the ISS reached out to DHOs and digital humanitarians instead. Trusting that the Arab Spring was as much an online revolution, with lots of available data, Brendan McDonald, head of the ISS, requested the development of a live crisis map in order to gain valuable situational awareness. To deal with the security challenges that can become prevalent when crisis mapping in hostile environments, two live maps were developed; one, with a 24-hour delay and incomplete information, was open to the public, while the second one, fully updated in real-time, was password protected and accessible only by the humanitarian community.

Various testimonies vouched for the positive role played by the Libya crisis map; Josette Sheeran, Executive Director of the United Nations World Food Programme (WFP), stated that the live map was instrumental in her organisation providing aid along the Tunisian and Egyptian borders. Overall, the Libya crisis map was populated with over 2,000 reports (Bailard et al., 2012; Walsh, n.d). According to Patrick Meier, the Libya crisis map experience also served another important purpose; it brought to the realisation that advanced computing technologies would have to be developed to take some of the burden off digital humanitarians. This understanding was one of the catalysts for technological developments such as AIDR (K. Collins, 2013). Figure 12 shows the Libya crisis map. The grey box highlights how, upon request of the UN OCHA, SBTF began undertaking crowdmapping efforts that

tapped a number of sources, including social media and news reports. Similar to the Ushahidi crowdmap, the red dots show reports that have been added. The right hand side of the screen details the categories of these reports.



Figure 12 - Libya crisis map (Bailard et al., 2012, p. 23)

The Libya response was, ultimately, an improvement over the Haiti one in terms of information exchange amongst partners and better organised workflows. In comparing Libya with Haiti, Patrick Meier noted, *"I'm amazed at how far we've come since the response to the Haiti earthquake"* (Meier, 2011a). Meier (2011a) highlighted many reasons for this, including the fact that no new crisis mappers needed to be recruited, meaning that no time had to be spent training contributors, and no new protocols and workflows had to be set up from scratch. For the Libya crisis, SBTf activated the map and existing practices developed during previous experiences. Furthermore, the request for its activation came specifically from the UN OCHA, which had not been the case in Haiti. Reflecting on the Haiti activation, Patrick expressed that *"there was no precedent for the crisis mapping efforts we launched at the time. We did not have buy in from the humanitarian community and the latter was reluctant to draw on anything other than official sources of information. Crowdsourcing and social media*

were unchartered territories. OCHA also reached out to CrisisCommons and OpenStreetMap and we are all working together more closely than ever before” (Meier, 2011a).

5.5.2 The Japanese Response

During this period, another crowdmapping activation took place, this time in response to the 2011 Japanese earthquake and tsunami, which killed over 15,000 people. This was an important response, as it showed the requirement and importance of crowdmapping even for a crisis occurring in a developed country (the majority of previous activations had been in developing countries). The disaster destroyed critical communication infrastructure, such as mobile phone communications. OSM played a critical role in the crowdmapping response, with Japanese contributors developing a live crowdmap in response to mapping needs. The response also saw the use of Twitter with, on average, over 3,000 tweets being mapped every week in the first month. As there were limitations in the timely and relevant information obtained from the Japanese government, the Sinsai.info crowdmap was extensively used, with over 500,000 people accessing it. Further support was provided throughout by SBTF (Bailard et al., 2012).

Further crowdmapping deployments have also taken place after Haiti: in Sudan, where Ushahidi was used to monitor multi-party elections; and in Egypt, where it was used to monitor parliamentary elections (Bailard et al., 2012). The 2012 response to Hurricane Sandy also witnessed the extensive use of social media (K. Collins, 2013).

5.6 Technology

Since Haiti, the technology used for humanitarian response has been subject to change and continual evolution. The technologies explored in this section include: MicroMappers, Twitter, AIDR and Verily, and HOT and Ushahidi technological components. Humanitarian response has clearly benefited in a number of ways from the development and implementation of these technologies; as is highlighted in the humanitarian responses detailed in this case study.

5.6.1 MicroMappers

SBTF developed MicroMappers in 2012 with the purpose of leveraging crowdsourcing capabilities, sorting through vast amounts of tweets, and determining which affected areas require most assistance; the relevant information is then displayed on a crowdmap.

MicroMappers was first used in the aftermath of the 2013 Pakistan earthquake that killed at least 300 people, but it was only used extensively during the response to Haiyan (K. Collins, 2013). Therefore, its use is discussed in more detail in the section dealing with the latter event. Figure 13 shows the MicroMappers platform, in which contributors look at the content of a tweet and label it accordingly. For security and credibility reasons, each tweet is checked by three contributors and only moves on to next verification phase if it is tagged the same way by all three.

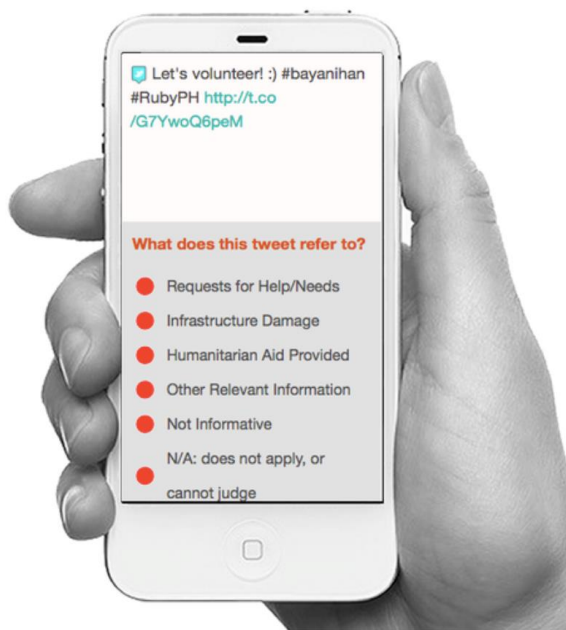


Figure 13 - MicroMappers interface in action during Hagupit (Meier, 2014a)

Figure 14 shows the ImageClicker interface, which goes through the same process, but with images instead of tweets.



Figure 14 - ImageClicker interface (Meier, 2013d)

5.6.2 Twitter

The Twitter social media platform finds itself being increasingly used in humanitarian response; it therefore cannot be ignored when exploring technologies suited for humanitarian response. Launched in 2006, Twitter *“is a communication platform that allows users to broadcast 140-character messages (tweets) to groups of other users who subscribe to their accounts (followers). In turn, Twitter users (twitterers) receive tweets from the set of users they elect to follow. For twitterers whose accounts are not explicitly set as private, every tweet is also posted to a public, searchable timeline”* (Starbird and Palen, 2011, p. 1071). As Twitter had not been expressly developed for humanitarian response, many have argued that it has *“become a crisis platform by accident”* (Goolsby, 2010). Furthermore, other technologies, including Ushahidi and MicroMappers, leverage Twitter for their objectives. Finally, Twitter has also been used as an information distribution channel. The role played by Twitter during humanitarian responses is showing no signs of abating, especially when the other technologies mentioned leverage the platform for humanitarian response. Comparing Twitter with other social media platforms, K. Collins (2013), argues that *“other platforms don't elicit the same kind of information from people, and neither is the information they do collect particularly accessible. Facebook's terms of service mean it's harder to filter public updates, Foursquare isn't as international, or really used by people during disasters, and you can't access metadata for the pictures on Instagram unless they are also posted as a geotagged tweet – although even that doesn't guarantee accuracy”* (K. Collins, 2013).

5.6.3 Verily and AIDR

Further technological innovations have been launched. Two of these are Verily, which utilises the crowd to verify information, and AIDR, which utilises machine learning techniques to recognise informative content on Twitter (Meier, 2013a, 2014d).

A major issue reported by humanitarians with regard to social media data is that they cannot be verified; Verily was developed as a solution to this problem. Verily works by asking contributors verification questions of varying difficulty, but, beyond just seeking yes or no answers, it further engages with them by asking for the reasons behind their answers. For example, the Verily challenge in figure 15 displays an image of a location and asks whether or not it is a picture of Rome. Within four hours, the challenge was answered correctly by a contributor who correctly stated that it was, in fact, a picture of the Sicilian town of Caltagirone; the contributor had selected 'no' and, as evidence, had posted a photo of the same street (Meier, 2014d).



Figure 15 - Verily Rome Challenge (Meier, 2014d)

Further Verily challenges are shown in figure 16. These include showing an image and asking the crowd the following questions: “Is this lake Kastoria?”, “Is this Milan?”, and “Is the Queen Victoria docked at Southampton?”

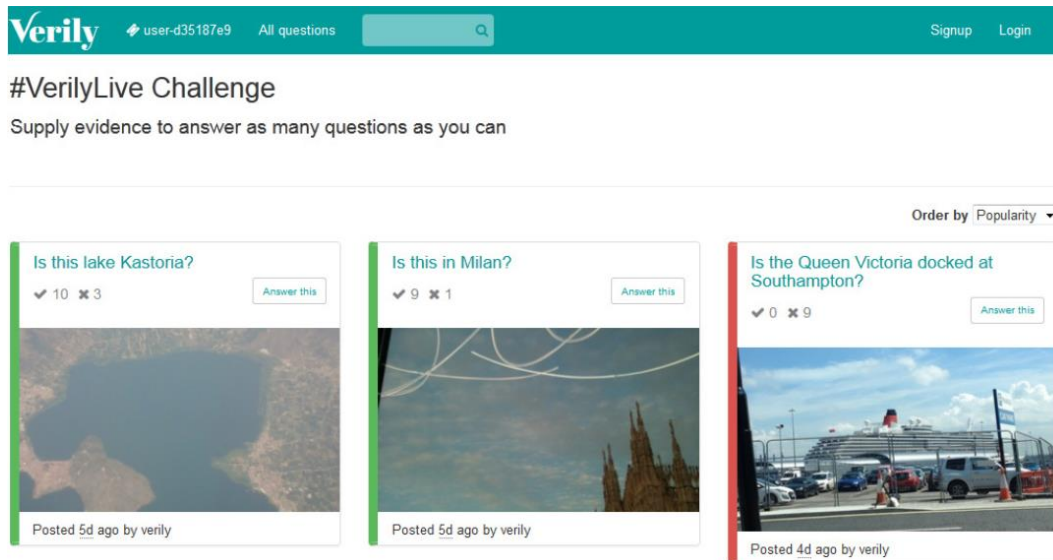


Figure 16 - Further Verily Challenges (Meier, 2014d)

In identifying informative content on Twitter, AIDR goes further than similar platforms by looking beyond simple keyword searches; this is important because research has shown that these can cause over 50% of relevant content to be missed (Meier, 2013a). Further issues with simple keyword searches include language restrictions and multiple associated meanings depending on context. The machine learning AIDR platform overcomes these issues through its three component system; collector, trainer and tagger. The collector collects the tweets, the trainer allows users to train the AIDR system to automatically tag tweets in a certain manner and, finally, the tagger aspect examines and analyses the user tagging, to tag further tweets in a similar manner (Meier, 2013a). Figures 17 and 18 show the AIDR collector and trainer components.

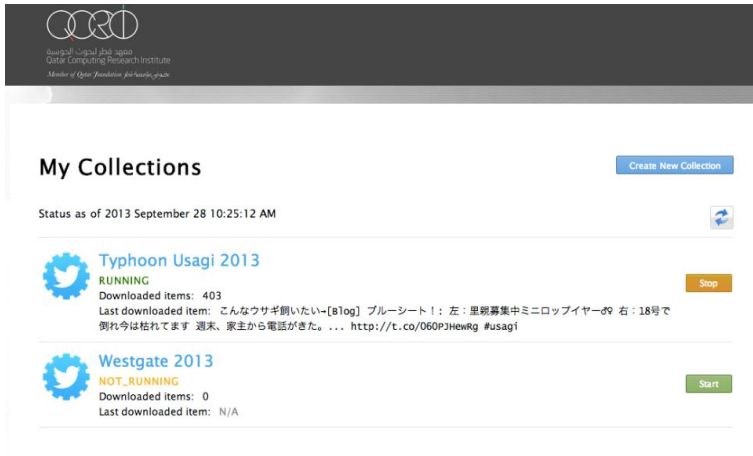


Figure 17 - AIDR collector (Meier, 2013a)

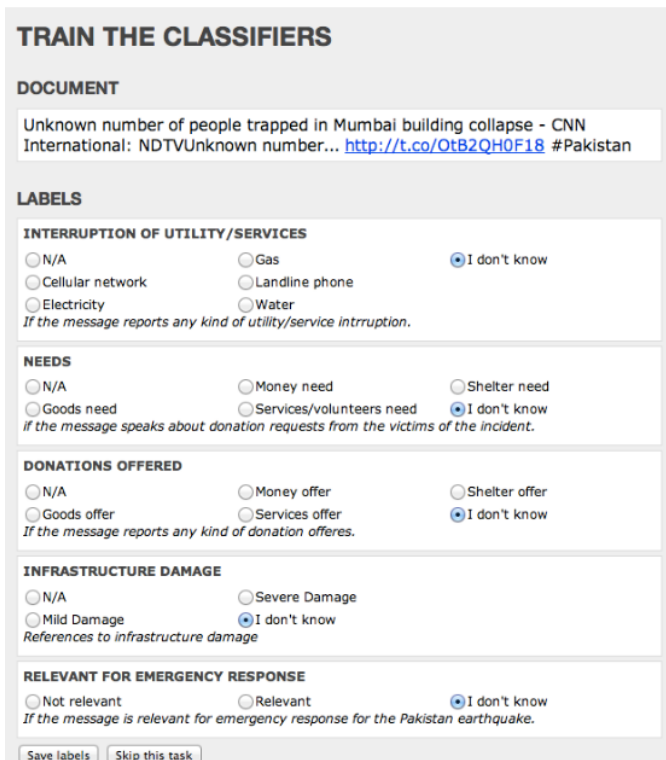


Figure 18 - AIDR trainer (Meier, 2013a)

5.6.4 HOT Technological Components

Since its inception, in the aftermath of the Haiti earthquake, HOT has seen the development of technologies such as the tasking manager, which is used to allocate tasks to contributors. The tasking manager has continually evolved over time; its development being central to HOT's crowdmapping system. Before the introduction of the tasking manager, contributors would make small edits to the crowdmap and, at best, could hope that their efforts would not

overlap those of other contributors. The three mapping editors (iD, Potlatch and JOSM) have also seen continual development. iD was launched in order to make mapping easier for new contributors, as a learning curve can be associated with Potlatch and JOSM. iD also enables contributors to map quicker over shorter periods of time. A few months after the Haiti activation, HOT also launched a mailing list to boost communication amongst contributors. Further developments have included the development of the HOT website, the emergence of the Mapbox stack, where processed satellite imagery is provided (Mapbox also initially helped develop iD), and the maturing of routing and extractions (Maron, 2010b). Figures 19 and 20 illustrate the early development of the HOT crowdmapping system, including the task screen and tasking manager.

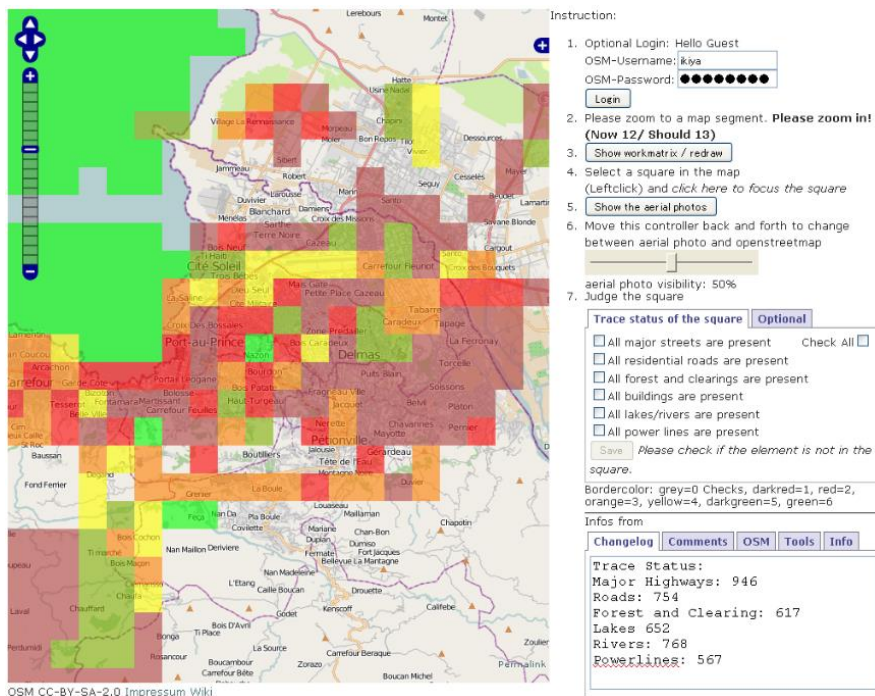


Figure 19 - HOT task screen (Meier, 2011b)



Figure 20 - HOT tasking manager (Meier, 2011b)

5.6.5 Ushahidi Technological Components

Ushahidi has also developed its technological capabilities since Haiti. Recognising the need for mobile functionality, it launched a mobile tool, named Crowdmapper, that enables the fully functional use of Ushahidi on a mobile platform. The Ushahidi team developed the tool after contributors requested greater flexibility and functionality for their posts and maps (Marshall, 2013).

5.7 The Haiyan Response

Typhoon Haiyan triggered the most significant digital humanitarian response since Haiti. Typhoon Haiyan (locally known as Typhoon Yolanda), was a powerful tropical cyclone that struck Southeast Asia—and, in particular, the Philippines—between the 6th and 9th of November 2013. The Philippines Government – National Disaster Risk Reduction and Management Council (NDRRMC) reported 6,201 fatalities, 28,626 injuries and 1,785 missing persons. Over 3.4 million families were affected, totalling over 16 million individuals in 591 municipalities and 57 cities (NDRRMC, 2014).

5.7.1 OSM

OSM was a prominent crowdmapping tool that was deployed in response to Haiyan. The OSM Haiyan crowdmapping system was activated by HOT on the 7th of November 2013, around 24 hours before Haiyan was to make landfall in the Philippines. The system was activated to initially focus on mapping Tacloban City, which an early analysis had predicted would sustain the greatest damage. This estimate was based on HOT Activator Andrew Buck’s research from media sources, including a weather blog. An email was then sent out by Andrew to the HOT mailing list, calling upon OSM contributors to participate in the mapping activity. By the end

of the activation, the mapping efforts had gone beyond Tacloban City, to cover the majority of the affected areas. Throughout the activation, Andrew was assisted by Maning Sambale, Vice President of OSM Philippines, and Pierre Beland, a board member at HOT, amongst others. This was done in coordination with the American Red Cross, which worked closely with HOT during the activation, as it was operating on the ground and continually advising HOT upon the areas that needed to be mapped.

Overall, by the end of the OSM Haiyan effort, around 1,679 contributors from 82 countries had engaged with OSM’s technological properties, making, in total, around 4.7 million changes to the relevant maps. Over the response period, the number of contributors grew continuously, with over 1,000 reported in the first week alone. This far exceeded any other HOT contribution, such as the response to the Haiti earthquake, which had not exceeded 700 contributors. Looking at the OSM contributor group in general, between January 2010 and January 2015, the number of contributors has grown from around 200,000 to over 1.9 million. This is shown in figure 21.

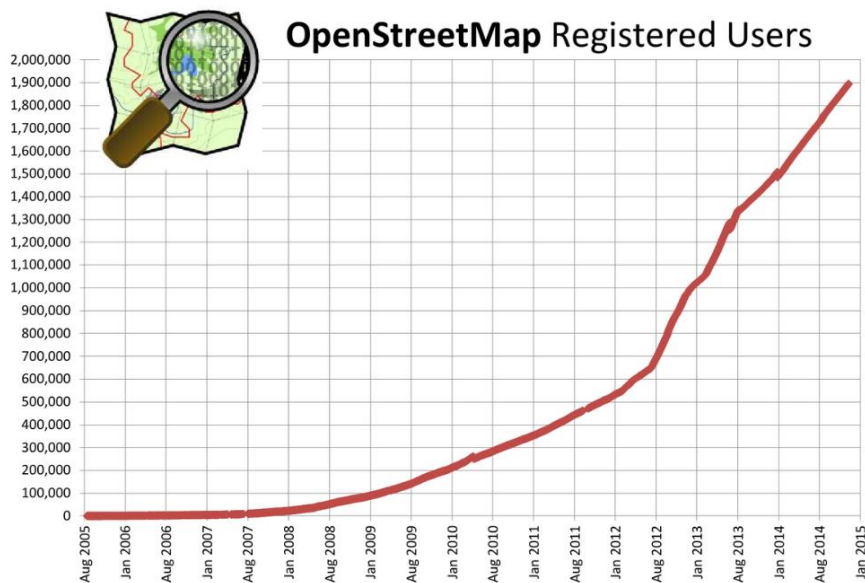


Figure 21 - Number of OSM contributors (OpenStreetMap, n.d-b)

During Haiyan, HOT’s purpose was to provide continuously updated maps, reflecting the changing situations, to the various humanitarian organisations that operated on the ground. Confirming the purpose of the OSM Haiyan initiative, HOT Director Kate Chapman stated that

“in the Philippines, what we’ve done is we’ve reached out to agencies with map information” (Falconer, 2013).

The activated crowdmapping system detailed a map of Tacloban City and other affected regions, broken down into small areas. The tasks were coordinated by HOT; humanitarian organisations would pass on various mapping tasks to HOT, which would then list these online, to be actioned by the OSM contributor community. Acknowledging HOT’s role during the response effort, Andrej Verity, overseer of crowdsourcing activities for the UN OCHA, indicated that *“the speed with which HOT has been able to digitize the affected areas in order to provide base layers for mapping products has been incredible for us”* (Butler, 2013). The tasking manager allowed HOT to define the areas that needed to be mapped by the contributors. The contributors would select a task, or be given one at random, then pick the desired editing tool (JOSM, iD or Potlatch), and use satellite imagery provided by HOT.

The tasking manager also enabled more experienced contributors to undertake validation tasks in which they would validate or invalidate contributions made by others. The three editors were suited to the contributors varying mapping abilities; whereas iD and Potlatch are browser-based editors more suitable for beginners, JOSM is a desktop application that requires contributors to download and configure various plugins. For the most part, Bing imagery was used to develop pre-disaster maps, whilst that provided by DigitalGlobe was used to develop post-disaster ones (OpenStreetMap, 2013c). Examples of tasks from Haiyan went from tracing isolated buildings and road networks to mapping entire cities, such as Tacloban City, which was severely damaged. Request examples included *“Use new satellite imagery to trace buildings, infrastructure, areas, natural features and other important visible features of the city of Ormoc,”* and *“Map the current state of Tacloban City area after Typhoon Haiyan inflicted heavy damage to buildings, infrastructure and areas”*. Instructions on how to successfully complete the tasks were included in the tasking manager. Figure 22 shows the tasking manager used for the Haiyan response.

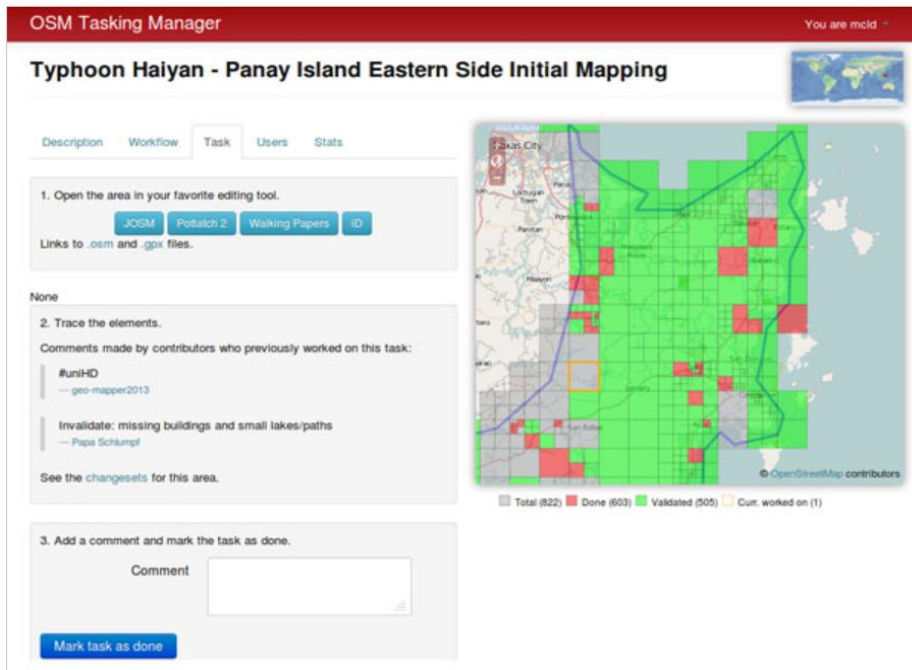


Figure 22 - The HOT tasking manager used for the Haiyan response (C. Silverman, 2014)

The vast majority of contributors that added to the Haiyan OSM were not professional cartographers. Rather, many of them were individuals from various professions and all walks of life that had, in part, been recruited through social media channels; many were made aware that they could contribute through the HOT twitter handle (@hotsm), which also acted as a motivator. The eagerness to participate in the relief efforts was emphasised by one contributor; *“it’s amazing to be able to help – there aren’t many opportunities to do this for a humanitarian organisation”* (RedCross, 2013).

Moving onto the actual maps, figure 23 shows the ‘before and after’ maps of Tacloban City, which demonstrate the results of the OSM contributors’ work in developing a richly detailed map. It also highlights the issues faced by humanitarian organisations with pre-existing maps. The ‘before’ picture shows the detail of Tacloban City presented on the map that was initially available to humanitarian organisations. As can be seen, the map was too scarcely populated, in terms of roads and infrastructure network, to be of any real assistance to humanitarian organisations. The ‘after’ picture shows the work done by OSM contributors; it is a much more comprehensive map and was effective in support of humanitarian organisations in their relief efforts.

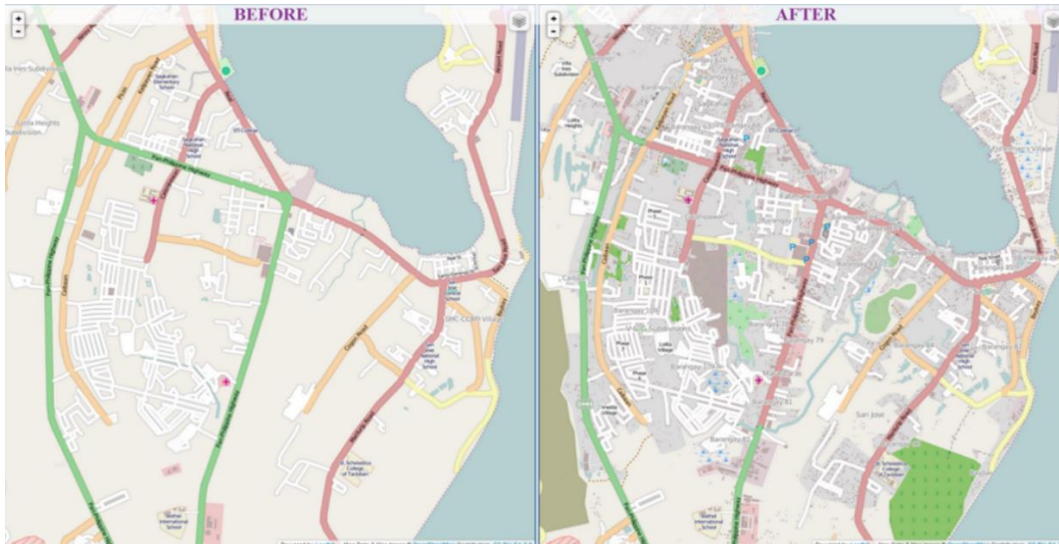


Figure 23 - OSM before and after the crowdsourcing initiative (Hern, 2013)

An effort was made by humanitarian organisations, including the American Red Cross and the UN OCHA, to obtain satellite imagery (Hern, 2013). The Haiyan crisis represented the first time that a crowdsourced medium had been used to such a great extent by the American Red Cross for its disaster response. Dale Kunce, a Geospatial Architect & Developer at the American Red Cross, stated that the American Red Cross had recently begun to use open-source software and data as this reduced or even eradicated project leave-behind costs. Highlighting the importance and usability of maps, he further stated that *“having maps of a place is very important for people coming from international organizations. Maps provide a lot of utility, such as understanding distances and the spatial context of knowing where you are. A lot of places have never had a map... we feel very strongly that the way forwards is to embrace open standards and open-source software, and of course OpenStreetMap... OpenStreetMap serves as the foundation, base map and data store for the Red Cross. It's also really cheap and there's no vendor lock-in* (Cruz, 2013).

As stated above, the developed maps relied upon satellite imagery for completeness and accuracy. Humanitarian organisations, such as the American Red Cross and the United States Military relief effort (Operation Damayan), relied upon satellite imagery from the National Geospatial-Intelligence Agency (NGA), which operated through the United States Department of Defence. When Haiyan struck the Philippines, on the 8th of November, it took a considerable amount of time and negotiations (in the context of humanitarian response), for

humanitarian organisations to obtain the necessary satellite imagery, despite the fact that the NGA was already assisting the United States military relief effort (a senior Marine Corps officer stated that the United States military relief efforts relied on the key role played by NGA maps). After lengthy negotiations, humanitarian organisations were also granted access to these maps. For the most part, for the OSM crowdmapping system, Bing imagery was used to develop pre-disaster maps, whilst imagery provided by DigitalGlobe was used to develop post-disaster ones. Upon request by the NGA, DigitalGlobe made pre-Haiyan and post-Haiyan images available to the public (the original time frame of 30 days turned out to be incorrect, as this had been misunderstood by the HOT community). The delay in obtaining imagery from DigitalGlobe was of around seven to ten days and, because of this, some OSM contributors and HOT members started an online petition seeking the “quicker release of imagery” for a “longer period of time”. In the initial stages, when humanitarian organisations did not have access to satellite images, the NGA would provide the coordinates of the most affected areas and the humanitarian organisations would dispatch their teams there. This initial solution was not effective because the humanitarian organisations, such as the American Red Cross, were not made aware of, for example, damaged roads and, despite having the correct locations, they would be delayed in reaching them by being forced to repeatedly turn back after finding that the routes that they were travelling on were impracticable. As highlighted by Dale Kunce, it was imperative for the Red Cross to make as much data available to field responders and, in general, for field responders to be as self-sufficient as possible by having, amongst other things, their own maps (C. Clark, 2013; Cruz, 2013; McKenzie, 2013; Meyer, 2013; NGA, 2013).

After Haiyan had struck, DigitalGlobe, a commercial supplier of geospatial and satellite imagery, captured more than 19,000 square kilometres of the worst hit areas and made the images available to the crowdsourcing community. The Tomnod project, as it was named by DigitalGlobe, attempted to enlist the help of the crowdsourcing community to help map the damage caused by Haiyan with algorithms that assigned ranking tags in order of importance. Shay Har-Noy, the founder of the Tomnod project, stated that over 1,500 contributors were analysing images and over 150,000 damage areas were identified. Once they had been refined, the images were passed on to humanitarian organisations, including the American Red Cross and the United States Pacific Command. Shay Har-Noy further emphasised the importance of the contributor efforts and highlighted the most important ways in which

images had been populated; *“the most useful tags are damaged roads, damaged large buildings, and large areas of destruction”*, and *“if you can’t afford to give ten bucks, give ten minutes... this is about being able to unlock the value in our images, particularly in disasters, when time is of the essence”* (Wait, 2013). The National Aeronautics and Space Administration (NASA), the United States space agency, also assisted the disaster relief efforts by providing post-Haiyan satellite images. Scientists at NASA’s Jet Propulsion Laboratory collaborated with the Italian Space Agency and used a technique called Advanced Rapid Imaging and Analysis (ARIA), which attempted to detail any surface deformation caused by Haiyan. Overall, the collaboration produced detailed images of the most affected areas, including Tacloban City (Berkman, 2013; Kramer, 2014). Figure 24 shows the ‘before and after’ satellite images of an area devastated by Haiyan. These satellite images were used by OSM Haiyan contributors to crowdmap. The devastation left by Haiyan can be clearly seen in the second image, showing how the typhoon had destroyed much of the road and infrastructure network.

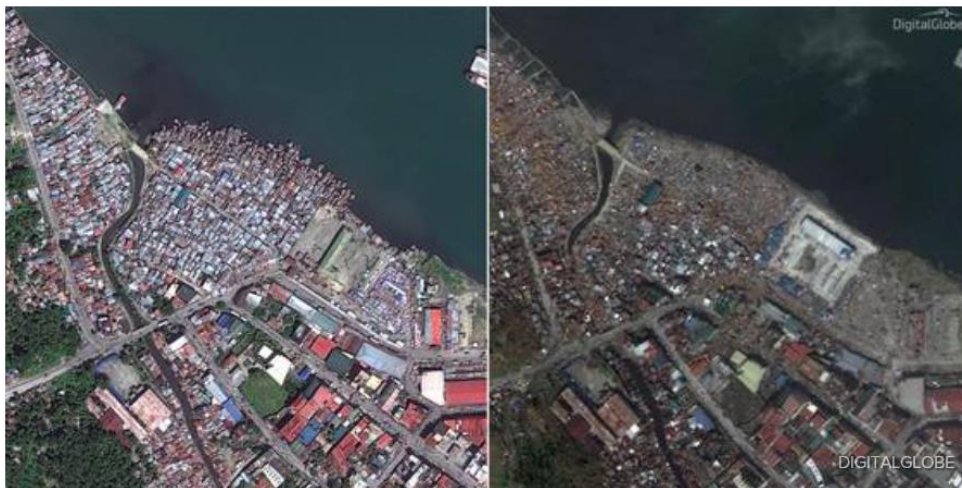


Figure 24 - Satellite imagery before and after (nbcnews, 2013)

Additional images taken by Unmanned Aerial Vehicle (UAVs)/drones were also made available, but these were limited; HOT most commonly used satellite imagery.

Poster sized crowdmaps were delivered by HOT to the Philippines Department of Social Welfare and Development (DSWD) operations centre at Tacloban airport, where they were actioned by humanitarian organisations. After they had been distributed to relief workers on the ground, the American Red Cross used these crowdmaps in a variety of ways. Helen Welch, an Information Management Specialist at the American Red Cross, was despatched to the

Philippines with three of her colleagues and took with her over 50 crowdmaps of affected areas, including Tacloban City. The crowdmaps carried by Helen Welch preceded the majority of changes made by OSM contributors. This meant that new crowdmaps were constantly being pushed to the field to reflect the changes made by the OSM contributors; within a 12-hour period of Helen Welch landing in the Philippines, her team's crowdmaps had already been updated about three or four times. As internet connectivity was limited in many of the areas that needed aid, hard copy maps were crucial.

Robert Banick, a GIS Officer for the American Red Cross, who assisted in the relief efforts on the ground, also highlighted the importance of OSM for the Red Cross teams, stating that *"maps saved them from getting lost or wasting time when they had to reroute off damaged roads. They were able to give directions to Filipino drivers. It all leads to more efficient delivery of supplies to people affected by Typhoon Haiyan. The effort and attention that is paid to collecting data for maps is super important. Desk jobs sometimes get short shrift, but the output we produce makes a huge difference"* (RedCross, 2014). Specifically, the American Red Cross used the maps for distribution and navigational purposes. These included the distribution of non-food items, such as tents, tarps, jerry cans and blankets, as well as cash distributions and the setting up of water distribution and sanitation areas. It also used maps for non-logistical purposes, such as marking boundaries and adding population estimates to the OSM base layer map.

The aftermath of Haiyan saw the development of the imagery coordination tool/group, which enables greater coordination and collaboration between the actors involved in imagery procurement. HOT can now make requests that can refer to any specific area and request imagery for it. The imagery providers receive them and appropriately supply the requested imagery or provide details as to when it will become available. The American Red Cross has also realised that it needs to improve its technological capabilities in order to fully capitalise on crowdsourcing capabilities. Technologies are being developed to improve the real-time crowdmap distribution process and to make it less bandwidth intensive. Furthermore, the American Red Cross has taken measures to improve the technological capabilities of HOT—namely, the tasking manager. Improvements have been made to task allocation in terms of non-square task support and to cater for different skill levels. Other changes have been made

to enhance the overall user-interface and user-experience (L. Clark, 2013; Cruz, 2013; Meyer, 2013).

Finally, to recruit further contributors in support of OSM Haiyan, regular mapathons were held in various cities across the world. These mapathon events, which gave contributors an opportunity to meet each other and learn how to contribute to OSM, were held, among other cities, in Manila, Quebec City, London, Tokyo, Zagreb, Vermont and Paris (OpenStreetMap, 2013b; Zipf, 2013).

Table 15 details a timeline of the major OSM incidents that took place during the response to Haiyan, beginning 24 hours before the typhoon struck the Philippines (7th of November), and ending on the 11th of December, when most of the response stage relief efforts had ceased.

Table 15 - OSM Haiyan activation timeline (OpenStreetMap, 2013b)

<u>Date</u>	<u>What Happened</u>
7 th November	OSM contributors began to map Tacloban City, which was forecasted to be hit heavily, 24 hours before Haiyan was due to strike.
10 th November	<p>HOT declared the Haiyan response to be its main priority.</p> <ul style="list-style-type: none"> - Contact and coordination was set up with various actors, including the UN OCHA, the Red Cross and the US Department of State’s Humanitarian Information Unit (HIU). - The International Charter ‘Space & Major Disasters’ was activated, with imagery suppliers realigning satellites to obtain post-Haiyan images. - HOT imagery specialists began to look for images and to make these compatible with the OSM interface so that contributors could access them. - A revised humanitarian mapping workflow was proposed that used a tagging scheme for damaged infrastructure. Furthermore, various tools were adapted to deliver suitable maps.
11 th November	The European Commission released the first post-Haiyan images of Tacloban City.
13 th November	The HIU released post-Haiyan images through DigitalGlobe. The first post-Haiyan task manager was made available to enable contributors to look at the damage in Tacloban City.
15 th November	More than 900 contributors had made contributions, with over 2 million map changes.
16 th November	Upon request of the United States government, DigitalGlobe made pre-Haiyan and post-Haiyan images available to the public for 30 days.
19 th November	More than 1,200 contributors had made contributions, with over 3 million map changes.

24 th November	More than 1,500 contributors had made contributions, with over 3.8 million map changes.
11 th December	More than 1,600 contributors had made contributions, with over 4.5 million map changes.

5.7.2 MicroMappers

MicroMappers, a set of crisis mapping tools used during Haiyan, capitalised on crowdsourcing capabilities to sort through vast amounts of tweets and identify the areas that required the most assistance by displaying them on a crowdmap. MicroMappers had been developed by SBTF, which, during Haiyan, aimed at providing crowdsourced data to the relevant organisations. The mapping process was carried out in partnership with GISCorps and ESRI.

During Haiyan, MicroMappers was used in collaboration with the UN; specifically, the UN OCHA. Haiyan signalled the first time that the UN OCHA had deployed officials that specifically dealt with coordinating contributor crowdsourced maps. Tweets were sorted in terms of ‘requests for help’, ‘infrastructure damage’ and ‘displaced populations’, and, depending on whether the tweet had been geo-tagged, the information was mapped. For quality control purposes, each tweet was checked by at least three contributors and was only accepted if it was tagged the same way by all of them. All accepted tweets were then checked by SBTF to ensure further accuracy. The data was then passed to the UN in the Philippines, which held the ultimate responsibility for what they did with the crowdsourced data. The UN confirmed that the data received was used widely not only by itself but also by other humanitarian organisations. Highlighting the importance of maps during the response to Haiyan, Russ Johnson, ESRI global director for public safety and emergency response, stated that *“with a live map, they can examine what the current needs are”* (Falconer, 2013). He further affirmed that crowdsourcing enabled humanitarian organisations to identify the locations at which resources were needed most and how different organisations had begun to request developed maps; *“I don’t know how you’d do that without a map... we’re getting tremendous hits (in Philippines map traffic), our maps are being integrated with a number of organisations in websites”* (Falconer, 2013).

Within 48 hours of the disaster striking, MicroMappers was able to pass on to the UN OCHA around 35,000 quality control checked tweets for its crisis map. In total, MicroMappers was run for five days, with 55,000 tweets being collected after quality control, while the

ImageClicker component of MicroMappers received over 7,000 images. Furthermore, whereas the UN's rapid assessment process would normally have taken five to seven days, the digital humanitarian response enabled it to be cut down to only two. Patrick Meier, co-founder of MicroMappers, stated that the response was global, coming from every continent excluding Antarctica. (Butler, 2013; Howard, 2013; Meier, 2013c; Zipf, 2013).

Figure 25 illustrates the MicroMappers interface used during the response to Haiyan (the image shows how the interface was displayed on a compatible mobile phone). The top half displayed the tweet, which, in this case, highlighted a specific need for food over other types of aid. The bottom half of the image highlighted the possible responses that could be selected by the MicroMappers contributor. Presumably, out of the six options available, this contributor would have clicked the second: a request for help/needs. As per the MicroMappers' security features, this tweet would have been checked by three contributors and would only have been moved on to the next stage if all three had selected the second option.

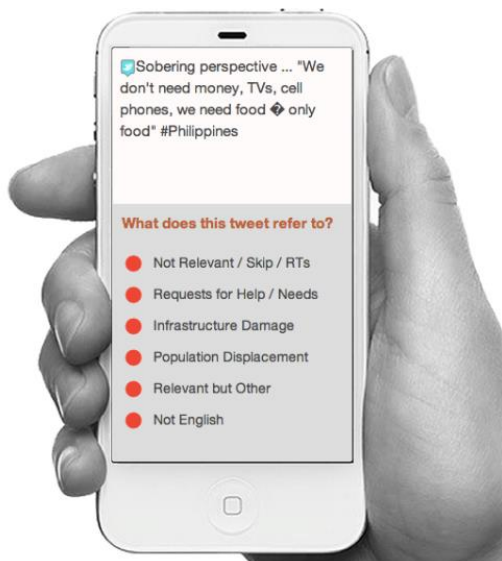


Figure 25 - MicroMappers interface (Meier, 2013c)

Once the tweet had been security verified, the geo-tagging element of the tweet would have come into play. The blue twitter signs shown on figure 26 detail the map, showing exactly where the requests had come through, with precise coordinates that could then be actioned by humanitarian organisations.

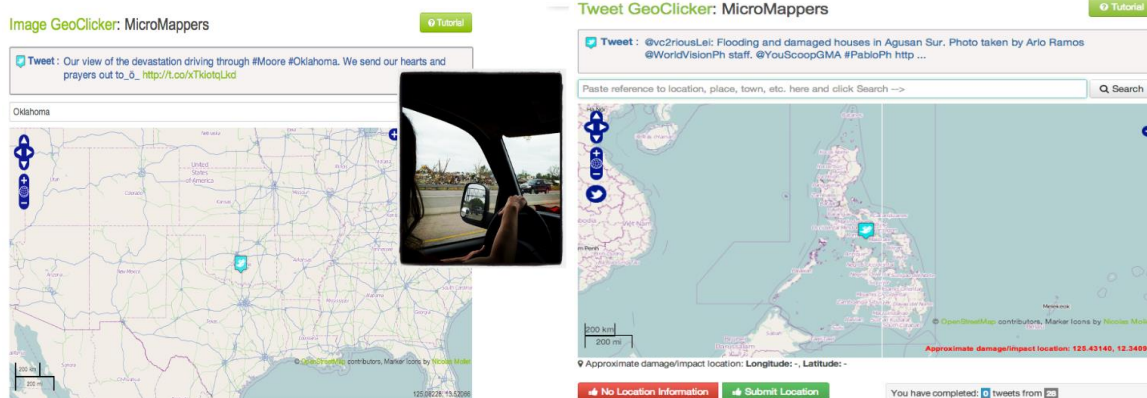


Figure 26 - MicroMappers (Meier, 2013c)

5.7.3 Other Mapping Efforts

Various other crowdmapping efforts took place during Haiyan. The Philippines Government – Nationwide Operational Assessment of Hazards (NOAH), provided a detailed map presenting information collated from different crowdsourced applications and social media tools (Mann, 2013). In another effort, a group of IT professionals in the Visayan Islands developed the crisisreliefmap.ph website, which allowed different users to upload crowdsourced data onto a map. Images of the damage caused by Haiyan were shown on the map along with other information, such as locations in which aid was most needed. Specifically, Facebook was used as a tool for users to contribute to the crisis relief map (SunStar, 2013). The GIScience Research Group at Heidelberg University set up a crisis map that attempted to bring together different layers from different sources (Zipf, 2013). The layers were visualised according to population density and elements at risk. Furthermore, the crisis map displayed unnavigable roads and damaged buildings through a map layer from OSM. Geo-tagged images were added from Instagram. The elements at risk layer contained information related to critical structures, including hospitals and schools.

Another prominent crowdsourced technology that was used in response to Haiyan was the Google suite for crisis response. This included crowdsourced maps that highlighted hospitals, command posts, relief drop zone areas and evacuation centres. Furthermore, the map also included climate and weather conditions, with red alerts for the most affected areas (Gordon, 2013; Hall, 2013; Mann, 2013; Woods, 2013). Figure 27 demonstrates how google maps were used during Haiyan; for example, heat maps detailed a damage assessment of Tacloban City

with damage reports of specific parts of the city. The colour red on the map revealed areas that were completely destroyed, while yellow signalled those possibly affected. In between, two shades of orange highlighted highly affected and moderately affected areas.



Figure 27 - Google crisis maps (Gordon, 2013)

Maps also contained the information highlighted in figure 28 below, detailing evacuation centres, hospitals and health centres, command posts and vital infrastructure, and police stations.

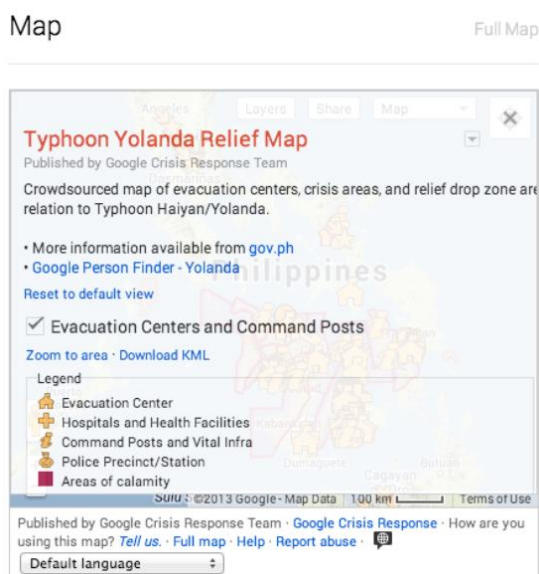


Figure 28 - Google crisis map legend (Woods, 2013)

5.8 Partnerships and Agreements

Since Haiti, a number of partnerships and agreements have been put into place to leverage digital humanitarians and the technological advances detailed above. This section explores these from the point of view of digital DHOs, including partnerships and agreements with humanitarian organisations, such as UN agencies and the Red Cross, and also with imagery providers, such as DigitalGlobe and GeoEye. On many occasions, governmental agencies such as the United States Department of State have assisted in imagery procurement programs including Imagery to the Crowd, which is discussed below. Also, some of the initiatives that DHOs undertake with the local affected communities are discussed, specifically those undertaken by HOT.

As discussed in the section dealing with the rise of DHOs, a number of these have developed in the aftermath of Haiti and work closely with humanitarian organisations, such as the Red Cross and UN agencies, to cater for their needs. Furthermore, DHOs such as HOT seek to develop partnerships and agreements with individuals, groups and hubs in local communities affected by disasters to help them become more resilient. The growth of these partnerships and agreements has been instrumental in the development of crowdsourcing and crowdmapping as a whole, with humanitarian organisations increasingly turning to DHOs to fulfil their needs. The development of the DHNetwork is a prime example of this trend and heralds the increasing formalisation of the relationship between DHOs and humanitarian organisations. This has made activations more effective, as there is a clear understanding of what is required and needed from the digital humanitarians whereas, during Haiti, the digital humanitarians were pushing out the information that they assumed would be useful rather than what was specifically requested or needed. It is a shift towards a more ‘need based’ response, rather than a ‘supply based’ one. This reinforces the idea that partnerships and preparedness, together with effective humanitarian technology, complement and support the humanitarian efforts on the ground (Meier, 2013b).

Crowdmapping systems such as OSM rely on the satellite imagery provided to contributors, who then trace the imagery into a map format. The satellite imagery is supplied by different providers such as DigitalGlobe; the partnerships between DHOs such as HOT and satellite imagery providers—including DigitalGlobe and, previously, GeoEye—have been continually evolving since Haiti. Government initiatives have also been launched to support imagery

procurement; for example, Imagery to the Crowd was launched in 2013 with the objective of purchasing imagery from the likes of DigitalGlobe under specific licences that would enable it to be used for humanitarian purposes. Imagery to the Crowd was launched by the United States Department of State and, as articulated on behalf of HOT by Mikel Maron, who made use of Imagery to the Crowd, *“HOT needs current aerial imagery to create up to date maps following a disaster event. The US government acquires that kind of imagery from commercial providers. Sharing the imagery with the OSM community means better maps for responders”* (Maron, 2013). Further partnerships and agreements have also been set up to support imagery procurement post-Haiyan; one such is MapGive, which is further discussed in the after Haiyan section.

An example of how HOT works with local communities is provided by their efforts in Haiti. In the aftermath of Haiti, various HOT representatives, including Nicolas Chavent and Robert Soden, flew out to Haiti to advocate the use of OSM on the ground with the Haitian government, Haitian society, and various humanitarian organisations, including the UN and MapAction. The idea was to promote and allow OSM to be beneficial in the recovery and reconstruction of Haiti. Further emphasis was placed on the use of OSM to help Haiti in its long term development. Hands-on training and detailed deliberations were used to assess mapping needs and find ways in which to integrate OSM into addressing these needs. The issues that were focussed upon included developing a detailed road network (HOT, 2010; Maron, 2010c).

Another initiative, named Communauté OpenStreetMap Haiti (COSMHA) and funded by USAID/United States Agency for International Development's Office of Transition Initiatives (OTI)/Haiti Recovery Initiative (HRI), was developed with the objective of ensuring that the best map data for Haiti were provided by Haitians and made available to all for use and further improvement. The purpose of the project was to bring the local Haitian communities of Saint Marc, Arcahaie and Cabaret together for mapping purposes; in total, the project involved 30 youths from these communities. By supporting and developing the COSMHA project, HOT continued to remain active in Haiti well after the earthquake. HOT's support, coupled with that of GrassRoots United, which was also active in Haiti, provided further advanced training on mapping along with technical and organisational assistance. COSMHA's ultimate aim was to be capable of sustaining itself independently through the people of Haiti and to function

without HOT's assistance. During the first three weeks, a team of ten people from HOT was based in Saint Marc to train the 30 youths in the art of mapping. Further training was provided on areas that included crisis mapping, GIS applied to humanitarians, urban planning, and geography (HOT, 2012).

5.8.1 After Haiyan

Partnerships and agreements have been evolving considerably post-Haiyan. This section explores the advances in the relationship between DHOs and satellite imagery providers, the exploration of alternative imagery procurement through the technological advances of UAVs, the development of various imagery related initiatives—specifically, MapGive—and mapping initiatives—specifically, the Missing Maps project.

The crowdmapping response to Haiyan heralded a more mature relationship between satellite imagery providers and DHOs; this was demonstrated, looking at HOT for example, through the development of the imagery coordination group/tool, which has enabled a more direct link with imagery providers. Information exchange between different actors has increased significantly since the Haiyan response; overall, the gap between digital humanitarians and humanitarian organisations is increasingly being bridged with every activation, as further lessons are learned and the existing trust is further reinforced.

More recently, alternative technologies aimed at outputting imagery for crowd-mappers have been explored; in particular, this includes UAV generated imagery. The move to complement satellite images with those from other sources has been acknowledged by humanitarian organisations such as the UN OCHA, which recently published an important policy document on the use of UAVs in the context of humanitarian response (Gilman and Easton, 2014). The document acknowledges the increasing role played by UAVs in civilian tasks, as their technology becomes more mainstream. It acknowledges the fact that humanitarian organisations have started using UAVs for mapping purposes, besides others that include data collection, situation monitoring, search and rescue, and public advocacy and information. Importantly, consideration is given to practical and ethical issues that apply to humanitarian organisations and to how these must be addressed through, for example, community engagement and transparency. Data and Privacy security issues are also being explored (Meier, 2014c). Picture 4 shows the UN OCHA's DJI Phantom UAV.

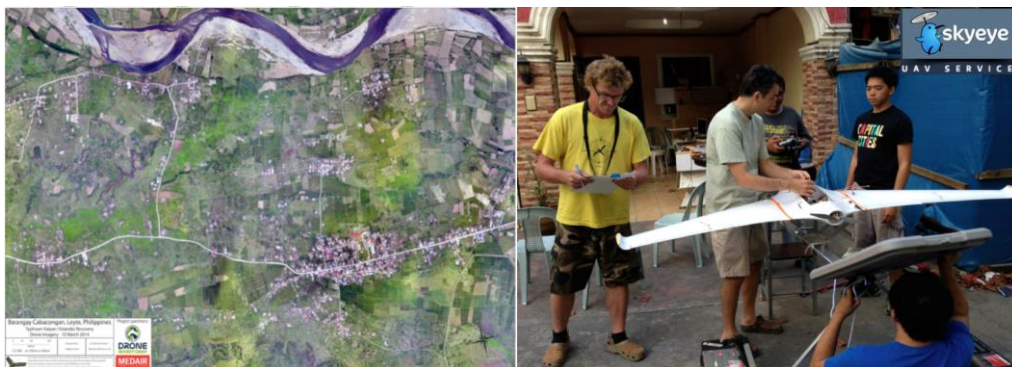


UN OCHA Asia Pacific @OCHAAsiaPac
OCHA's DJI Phantom #UAV ready for deployment during next humanitarian response #tech4good @markuswerne @PatrickMeier pic.twitter.com/lxjopMq8XR



Picture 4 - UN OCHA DJI Phantom UAV (Meier, 2014c)

In real-life cases, UAVs were used in the aftermath of Haiyan and also, recently, in Haiti. Picture 5 highlights their use in the Philippines, during Haiyan.



Picture 5 - UAVs in action during the Haiyan response (Meier, 2014b)

Various initiatives have also been launched to support the procurement of imagery. In March 2014, a program, named MapGive, was launched. This is a collaboration between the HIU and the Office of Innovative Engagement (OIE), with the objective of providing grassroots education on crowdmapping, its purposes, and on how people can get involved in it. MapGive had been in the pipeline since Haiti, but it only materialised in 2014. The introduction of Mapgive complemented the aforementioned Imagery to the Crowd program. Mikel Maron,

co-founder of HOT, stated that *“MapGive could be really useful for bringing in a lot of mappers from places that have been affected by disasters... I feel like there's an opportunity here to reach out even farther to places that haven't been exposed yet”* (McKenzie, 2014). All the various initiatives aimed at procuring imagery, be it through negotiations with satellite imagery providers or via alternative imagery channels, such as UAVs and drones, are examples of a new trend in humanitarian response, where the democratisation of imagery is taking place. The response efforts in Hagupit and Nepal have benefited from this development in partnerships and agreements.

Another initiative, called the Missing Maps project, was launched in November 2014 with the purpose of mapping the most vulnerable locations in the developing world. This mapping will provide humanitarian organisations with important mapping data, enabling them to respond to a spectrum of humanitarian situations in vulnerable locations before they fully unfold. Further objectives include supporting OSM—specifically, HOT—so that skills, technologies, communities and workflows can be improved and enhanced (Michael, 2014; OpenStreetMap, n.d-a).

5.9 Summary of Chapter

In summary, this chapter presents the case study on the development of crowdmapping in the context of humanitarian response. It traces the development of crowdmapping between 2009 and 2015 and describes the various developments and changes that have taken place over this period of time. It is useful to begin with the 2010 Haitian earthquake as the first major response, as this represents the disaster which saw the rise of crowdsourcing and, in particular, crowdmapping to increasing prominence. The major crowdmapping developments explored include, in chronological order, the Haiti response, the rise of digital humanitarian organisations, the 2011 Libya and Japan responses, technological advances related to crowdmapping, the Typhoon Haiyan response, and the development of the partnerships and agreements between actors since Haiti. The next chapter presents the analysis chapter.

Chapter Six: Analysis

This chapter presents the analysis of the main findings of the study. The crowdmapping system upon which this study focuses is OSM, which, in the context of humanitarian response, is activated and managed by the HOT community, with the crowdmapping undertaken by OSM contributors. This study covers a temporal boundary that goes from 2009 to 2015, and primarily focuses on two levels of analysis—namely, the community-level (HOT community) and organisational-level (Humanitarian Organisation One).

The rest of the chapter is structured as follows; the first three sections explore the evolution of meaning, domination and legitimation; evolving meaning and the emergence of legitimation within Humanitarian Organisation One in regard to crowdmapping for humanitarian response, and the challenging of domination by the HOT community in regard to the imagery procurement process. The fourth details the critical issues facing the aforementioned crowdmapping community. The fifth section explores the profile of the crowdmapping community. The sixth and final section presents a summary of the chapter.

6.1 The Evolvement of the Meaning of Crowdmapping for Humanitarian Response

The way in which Humanitarian Organisation One perceives crowdmapped data for their humanitarian response has evolved considerably since those early autumn days, in 2009, when the first ICCM Conference was held. This section details the key intermediaries (milestone events, experimental mapping and the use of maps on the ground) that have enhanced the meaning of crowdmapping within Humanitarian Organisation One; this change in meaning has led to the proliferation of crowdmapping within the organisation, in regard to their humanitarian response. Also, shared meaning in regard to crowdmapping capabilities for humanitarian response has developed between Humanitarian Organisation One and the HOT community.

6.1.1 The ICCM Conference and the Formation of the Crisis Mappers Network: The First Steps towards Enhanced Meaning

The 2009 ICCM Conference and the subsequent formation of the Crisis Mappers Network represent the two main events that sparked the process that resulted in the proliferation of crowdmapping within Humanitarian Organisation One, for their humanitarian response. The

conference and network brought together a diverse set of actors from both the crowdmapping and humanitarian organisation communities, besides some relevant ones from other communities. The actors included humanitarian organisations such as the UN and the American Red Cross, educational institutions such as Harvard and Princeton, as well as members of the crowdmapping community and government officials. The events provided offline and online spaces in which these diverse actors could learn from each other, and better understand each other's potential offerings and requirements. Specifically, the offline space was provided by the ICCM Conference, whilst the online one was provided by the Crisis Mappers Network.

The ICCM Conference was one of the first physical spaces in which a diverse set of actors convened to discuss crowdmapping in humanitarian response; the importance of this should not be understated as the event required many of the organisations attending to, at the very least, ponder over a somewhat new and different way in which to potentially carry out humanitarian efforts. At the time, Humanitarian Organisation One was not using crowdmapping in the undertaking of its humanitarian response efforts; for its representatives, as well as for those of many other organisations, the ICCM Conference was the first exposure to the idea of the crowd being involved in humanitarian response. Humanitarian Organisation One was already somewhat open to this idea because it had experienced the frustrations linked to trying to effectively carry out humanitarian efforts while lacking mapping data. So, from its point of view, the equation was quite simple; as it needed all the mapping data it could get to respond to humanitarian situations, but it did not itself possess the manpower necessary to efficiently populate the required maps, why not call upon the crowd to help?

The formation of the online community; the Crisis Mappers Network provided a space for discussion and the sharing of information, which it continues to provide to this day through its website, webinars and Google group. This meant that those organisations and actors that had hitherto been nowhere near communicating and potentially collaborating were provided with an online space in which they could do exactly that: communicate and collaborate. So whereas the 2009 ICCM Conference (and subsequent annual editions) provided the physical offline space, the Crisis Mappers Network enabled this to be taken further by providing a continually available virtual online space.

These two settings contributed to enhancing the meaning of crowdmapping for humanitarian response within the organisation. The effects of the ICCM Conference and Crisis Mappers Network would soon be put to the test by the 2010 Haiti Earthquake.

6.1.2 The Haiti Crowdmapping Response: The First Major Test

When the 2010 Haiti earthquake struck, various humanitarian organisations, including Humanitarian Organisation One, set up base in Port-Au-Prince; however, their humanitarian efforts were being hampered by a lack of mapping data. Acting upon this desperate search for actionable and complete maps needed to respond to the disaster, the Crisis Mappers Network enabled the pooling of a number of diverse actors into one place. It connected the humanitarian organisations that required up-to-date maps with the crowdmapping communities that could create them. Many of those communities were in their infancy and devoid of formal structure, which meant that their crowdmapping practices were being developed on an ad-hoc basis.

OSM was one prominent crowdmapping system that was engaged with by the humanitarian organisations on the ground. A HOT Board Member stated that;

“Haiti was perfectly aligned to the way that the OSM community can respond because the disaster was quite severe, a lot of loss of life, but also it was concentrated on a very small area of the earth’s surface, just a couple of cities, where the worst loss of life was concentrated and those cities had very poor existing mapping available. So it was absolutely ripe for the OSM community to come along and make a big difference”.

This quote highlights the conditions that enabled OSM to flourish during Haiti—namely, that it was a severe disaster involving a tragic loss of life in a small, concentrated area plagued by a lack of detailed maps. The immediate use of the OSM crowdmaps by Humanitarian Organisation One served to enhance meaning within the organisation in regard to how it could utilise crowdmapped data for humanitarian response purposes. The benefits of using the crowdmaps were more explicitly experienced by the field responders who were operating on the ground, but evidence that the Haiti experience had spread awareness of those advantages within the organisation was not overly manifest. Whilst some actors at Humanitarian Organisation One had acknowledged how useful crowdmapping could be, their endorsement had not percolated upwards to the senior positions of the organisation. A

Geospatial Architect & Developer at Humanitarian Organisation One highlighted the disconnect that existed between field responders and the more senior positions within the organisation;

“for Haiti . . . it was just like GIS people mapping because that’s what they thought would be valuable . . . with Haiyan you had the organisation looking at OSM to provide core data, whereas, in the Haiti disaster, it was like ‘Oh, these guys are doing this project over here’”.

Despite these instances of disconnect, the crowdmapping efforts made during Haiti generally received considerably widespread attention. This was highlighted by an Information Management Officer at Humanitarian Organisation Two;

“there was a lot of attention after Haiti on what the digital humanitarian community could do”.

6.1.3 The Establishment of DHOs: Establishment of Institutions

In the wake of the Haiti crowdmapping response, the crowdmapping communities realised that they needed to formalise their practices and structure; this demonstrated knowledgeability on their part, as they were able to assess how things needed to be improved to move forward. The importance and prominence of Haiti was also reinforced by a GIS Officer for Humanitarian Organisation One;

“I think, for the larger humanitarian world as a whole, everyone realised after Haiti... how valuable OSM could be”.

This further underlines the importance of the Haiti crowdmapping efforts for the evolution of crowdmapping in humanitarian response as a whole. The post-Haiti period saw the evolution of the crowdmapping communities into a number of DHOs. This resulted in greater formalisation and control of digital humanitarian efforts, as DHOs began to organise their practices in a more structured manner, mainly through the development of technological crowdmapping platforms. Essentially, the practices that had manifested themselves during Haiti had increasingly matured.

Importantly, the aftermath of Haiti witnessed the development of two major DHOs; HOT and SBTF. The implications of the Haiti response for the formation of HOT were highlighted by one of its board members;

“I think that, probably, Haiti was the big moment... HOT was formed off the back of the enthusiasm around the community response to Haiti. It’s kind of interesting that every disaster is different”.

6.1.4 The Crowdmapping Responses to Libya and Japan: The Institutions Are Put to the Test

The 2011 Libyan response provided an opportunity for these recently established institutions—the DHOs, including HOT—to be put to the test. The Libyan response advanced the wider cause of crowdmapping in humanitarian response due to two main reasons. First of all, the crowdmapping efforts took place independent of government participation. As the civil war was raging in Libya, humanitarian organisations decided against collating any information provided by the Libyan government out of fear that it may be inaccurate. Therefore, they began to rely mainly upon the DHOs, which proved to be key. Indeed, although this situation had been sparked by lack of trust in the information provided by the Libyan government, one unintended consequence was that humanitarian organisations realised that they could turn to the DHOs without government approval or instruction. Secondly, this greater reliance on crowdmapped information brought about another important realisation, this time by the crowdmapping community: that further technological development was needed to support digital humanitarians, as the burden being placed upon them was simply too heavy.

Notably, the Libyan response did not present the same conditions of the Haitian one, which had enabled the crowdmapping response to prosper. The Libyan response was of a slower, unfolding nature, as opposed to a sudden impact disaster, as it had been in Haiti. During Libya, it became apparent that not only was the crowd’s contribution important, but that the technology with which it engaged was just as crucial. The crowdmapping community had always been aware of the fundamental enabling role played by technology, but, at that particular moment, it realised that the existing technologies would have to be improved and that new ones would have to be developed to better leverage crowdmapping. This realisation

would result in continual innovation and technological development for humanitarian response—e.g. the development of the HOT tasking manager, MicroMappers, Verily, and AIDR; all technologies supporting digital humanitarian efforts. Furthermore, the Japanese response, that same year, was also important as it represented one of the earliest instances of a HOT activation in a developed country. In essence, the fact that humanitarian organisations, including Humanitarian Organisation One, were relying more on crowdmapped data than on other official sources made DHOs aware of the substantial role they could play in humanitarian response, regardless of local political situations and of official approval.

6.1.5 The Establishment of DHNetwork: Further Formalisation and Control

Despite the recent milestones reached in digital humanitarianism, such as the development of DHOs, the humanitarian community was still debating how contributor efforts could be better leveraged. The 2012 establishment of the DHNetwork was an important moment in furthering the cause of crowdmapping in humanitarian response. The DHNetwork was developed to enable networking between contributor and technical communities whilst providing a communication interface between formal, professional humanitarian, and contributor groups. Once more, this move highlighted the knowledgeability of the crowdmapping community, as it was again able to respond to the specific needs of that particular moment. The DHNetwork was developed to leverage the crowd in a more uniformed and organised manner by providing a link between the humanitarian organisations and DHOs and formalising the activation process. The entire activation process became more streamlined by the provision of specific instructions on how to activate contributor efforts. The importance of the DHNetwork was emphasised by Patrick Meier;

“Andrej Verity and I launched the DHNetwork in 2012, and Haiyan happened just about a year later; so we had a year, a year and a few months to streamline, to work on our standard operative procedures and to be ready for something like this as well, so I think that just the preparedness element meant that we were not as reactive as we had been in the past, I think”.

Importantly, as highlighted by Patrick, the efforts made to improve preparedness ensured that, when a disaster would strike, the communication amongst a diverse set of actors would be increasingly streamlined, and response efforts would be more active, rather than reactive.

6.1.6 The Gulu Crowdmapping Exercise: The Establishment of New Routines

In 2012, Humanitarian Organisation One undertook an experimental crowdmapping exercise in Gulu, Africa. That initiative allowed it to establish and enhance routines aimed at better using OSM crowdmapped data, for their humanitarian response;

“Gulu gave us a lot of confidence that, okay, we can try this in other areas” (GIS Officer, Humanitarian Organisation One).

These established and enhanced routines served well in the upcoming Haiyan activation as activities such as liaising with local partners and HOT were improved upon. Therefore, when the Haiyan activation came around, Humanitarian Organisation One already had some experience in regard to the practices required to utilise OSM;

“so we mapped this city in Northern Uganda called Gulu using OSM, and to do that we had, like in the Haiyan activation, to work through our local partners, like our local Red Cross partners, to actually implement based on it . . . we worked with the HOT team and sort of larger mapping communities that we knew, to get people involved in the first place” (GIS Officer, Humanitarian Organisation One).

For the Haiyan activation, Humanitarian Organisation One was able to use the experience it had gained from Gulu. Although exact mechanisms had not been put into place by the time of the Haiyan response, the practical experience gained from Gulu proved to be crucial, as it had detailed a clear cut before-and-after case—from having no map, to having a detailed one—to be used for humanitarian response efforts.

The outcomes or results of the Gulu initiative were important for Humanitarian Organisation One because they enhanced its understanding of how crowdmapping could benefit its humanitarian response efforts. This was aptly highlighted by a GIS Officer;

“in Gulu, we were blown away by how completely and thoroughly we were able to map a city that was basically just a blank spot on the map beforehand; and that gave us a lot of confidence that, wow, this is something that is really transformative and, like, sometimes you have great ideas and they don’t actually work out, like it’s just not appropriate for international development, it’s really difficult, like there are so many

logistical challenges to make these things work in the developing world, that we take for granted in the developed world, and so Gulu gave us a lot of confidence”.

The initiative was also important for Humanitarian Organisation One in developing a stronger bond with the HOT community in general. Humanitarian Organisation One used the Gulu crowdmaps in a number of different ways. It conducted training sessions, using OSM data, for the Ugandan chapter of the organisation, and also built up a good understanding of local infrastructure, which supported it in providing humanitarian relief. Specifically, OSM crowdmaps assisted Humanitarian Organisation One in its emergency response to traffic accidents and fires. It trained taxi drivers in high-traffic areas to act as emergency first responders in traffic accidents. In terms of fire response, it tackled preventing fires from spreading across tightly joined straw houses. The availability of accurate and complete maps was imperative, as these quickly provided the navigational capabilities needed to respond to these emergencies. In essence, the Gulu experimental crowdmapping exercise was important for Humanitarian Organisation One; this was stated by a GIS Officer. During Gulu, the organisation was;

“in the very unfamiliar and totally fantastic position of having more data than we know what to do with”.

6.1.7 The Haiyan Crowdmapping Response: Increasing Organisation and Control

When Haiyan struck, in 2013, previous experiences, such as the experimental crowdmapping exercise in Gulu, had still not fully convinced some at Humanitarian Organisation One that they should turn to crowdmapped data for their humanitarian response efforts. A GIS Officer, speaking about internal organisational discussions during Haiyan, articulated this;

“they were like, ‘Go and do mapping’, but they were not like, ‘Go and crowdsource’, we just sort of said, ‘Okay, this seems good’, and we started doing it, and then when it sort came time to, like, ‘Oh, we should make a call whether this is good or not’, the results were so clearly good and helpful that everyone was like, ‘Oh yeah, keep with that’”.

This shows that, although, within the organisation, some were still not fully convinced at the beginning of the Haiyan response, their opinions were at least partly swayed by the evidential results; this demonstrated their knowledgeability and reflexivity, as they were able to monitor

the crowdmapping response as it was unfolding and change their views accordingly. Although the idea of utilising crowdmapping for humanitarian response had not yet percolated the upper echelons of the organisation, the aforementioned events did benefit Humanitarian Organisation One. As highlighted by a GIS Officer, this included benefits stemming from discussions with HOT and scenario role-playing;

“the things that did work (from previous events) were we had done some preparatory discussions with the key members of the HOT team . . . some of their core volunteers who work on their responses had reached out to us and we talked about how theoretically we would manage a big response and we talked about a lot of things, about half of which actually turned out to be used during the operation but those were really important, that initial thought process really helped us”.

The evidential results mentioned by the GIS Officer referred to how effective OSM crowdmaps had been for Humanitarian Organisation One to fulfil their humanitarian response efforts on the ground. To begin with, Humanitarian Organisation One had used OSM crowdmaps as simple base maps that would provide them with situational awareness. The base-layer maps were overlaid with specific information, including the administrative boundary markings of the different municipalities in which the ground teams were working. This situational awareness enabled Humanitarian Organisation One to better understand the road and infrastructure network. An Information Management Delegate advised that OSM crowdmaps enabled this enhanced awareness;

“operational situational awareness maps, knowing and having the names of the places, like all the different barangays, the small administrative units on a map, knowing where they are in relation to each other and approximately how roads go through the area, was a huge help, having little customised road maps for them”.

This situational awareness provided by the crowdmaps made them suitable to be utilised for distribution and navigational purposes;

“in the early operation meetings, we had a bunch of international support coming in with really no idea about the names of provinces and islands or anything like that, and having a big map printed out and hung up on the wall that they could point to and kind

of understand where things are, which was definitely helpful” (Information Management Delegate, Humanitarian Organisation One).

To appreciate the importance of having up-to-date maps, the dynamics of Humanitarian Organisation One’s distributions during Haiyan need to be understood; these would, on average, involve four to five trucks and ten to 15 volunteers, with target population numbers ranging anywhere between a few hundred to a few thousand. If the navigation involved in all these different distributions could not rely on up-to-date maps, and thus lead to incorrect locations, potentially, much time would be wasted, delaying the distribution of the much needed supplies. This could, on occasion, be fatal, as these distributions would often involve the delivery of basic survival items to entire communities. Humanitarian Organisation One also worked closely with local teams and local people, including its Philippines chapter, with crowdmaps being handed out to local drivers. A Geospatial Architect & Developer at Humanitarian Organisation One articulated how effective the OSM crowdmaps were;

“one of our folks that was deployed said that they were trying to go to this place like several hours away from where the base camp was, and their local driver was like, ‘No, you can’t get there, the roads don’t exist’, but they had OSM on their tablet and they routed it on OSM, and they literally put it on the dashboard, and the driver begrudgingly followed the instructions on the tablet and drove them to exactly where they wanted to go, and they were able to see people and talk to people that no one had talked to at all, because nobody knew the roads were there”.

In essence, such was the effectiveness of OSM crowdmaps in covering the entirety of the affected areas for Humanitarian Organisation One that OSM more or less became the de-facto mapping source during the Haiyan humanitarian response efforts. As with Haiti, the Haiyan response developed under conditions ideal for OSM to flourish, including the high degree of severity of the disaster and the tragic loss of life.

In effect, this usage of OSM crowdmaps during such a severe natural disaster brought about a change amongst a wider audience within Humanitarian Organisation One. In essence, crowdmapping improved the overall humanitarian response, through the ability to navigate and distribute supplies to where required using OSM crowdmaps.

6.1.8 Achieving an Established Meaning of Crowdmapping for Humanitarian Response

This sub-section highlights the evidence that shows how the meaning of crowdmapping for humanitarian response has changed within Humanitarian Organisation One, leading to its proliferation within the organisation, legitimising it as a solution for the organisation's mapping needs, and, therefore, making it an integral part of the organisation's humanitarian response efforts.

To highlight the proliferation of crowdmapping for humanitarian response and its wider acceptance, a Geospatial Architect & Developer at Humanitarian Organisation One stated that;

"I don't think we have to sell it anymore, it's already sold. We did have to sell it, we had to convince people why it is valuable, but we don't have to do that anymore, it's proved itself. Now, crowdmapping is just part of what we do, it's just sort of anticipated and expected that we incorporate this into our projects and our disaster response".

Another representative of Humanitarian Organisation One, a GIS Officer, further emphasised the increased widespread backing now enjoyed by crowdmapping, which, as mentioned above, was not fully manifest before the Haiyan activation;

"I think Haiyan opened everyone's eyes and, now, even people that don't want to 100% understand still what OSM does recognise that we did something pretty major there and that we got good maps out of it, like some people were more understanding of how exactly that works compared with others, but they don't really have to understand that; as long as they can see it, we have a pretty strong institutional backing at this point to do this work, and to invest our time and energy into it, which is great, we proved our point".

This widespread backing is enabling the GIS team at Humanitarian Organisation One to approach major donors, seeking their support in projects that heavily leverage OSM;

"to go to a major donor, you need your senior managers to sign off on that; so, having that kind of commitment from them is huge and has allowed us to think bigger. We think that OSM is really cool and we want to make it a big part of what we do . . . we are not

afraid to put our name out there, put our name on reports, put our name on products, to spend our time working on things that are useful for the community and publish them and getting stuff behind it. We need senior managers to sign off on, 'Yes, this is a good use of your time and, yes, this is something that we want to develop as a speciality of ours...' That has happened and that has been really huge and allowed us to do a lot of work" (GIS Officer, Humanitarian Organisation One).

This highlights that the meaning of crowdmapping has evolved in Humanitarian Organisation One, and that crowdmapping is now viewed as part of their humanitarian response.

6.1.9 Summary

This section details that the meaning of crowdmapping for humanitarian response has evolved through a number of key intermediaries including offline conferences, online networks, the establishment of institutions, crowdmapping responses to international crisis and natural disasters, and crowdmapping experimentation. This meaning of crowdsourcing has emerged over time through these key intermediaries, and not in a sudden or surprising manner as the existing literature suggests—e.g. Brabham (2009), Heinzelman and Waters (2010), Majchrzak and More (2011), Palen et al. (2007), Palen and Liu (2007), Savage (2012), and Sutton et al. (2008). In an industry dominated by organisational actors, for crowdmapping to succeed, it has to be accepted as a credible source of information by organisations operating in the industry. This acceptance, as the analysis above details, did not occur suddenly, or because of one particular event. It occurred through a process of discovery where many intermediaries played an important role in advancing the meaning of crowdmapping for humanitarian response.

6.2 Challenging the Domination over Resources

OSM contributors were contending the domination over resources at the community level. Specifically, this dominance related to the process of obtaining the resources required by OSM contributors to crowdmap—namely, satellite imagery. The major turning point came shortly after the Haiyan crowdmapping response, which, through the development of an imagery coordination tool/group, saw a considerable challenge levelled at the power held by imagery providers over resources. This section details the key intermediaries (negotiations and exploration of imagery sources) that contributed to this power shift, which led OSM

contributors to obtain greater access to satellite imagery, reducing the control exerted by imagery providers over the imagery procurement process.

6.2.1 Online Petition: Protesting Power and Control

As satellite imagery is a crucial component for the undertaking of crowdmapping by OSM contributors, various actors have been involved in continuous discussions aimed at the release of such imagery. For instance, Humanitarian Organisation One has regularly liaised with imagery providers such as DigitalGlobe to obtain imagery on behalf of the HOT community. The discussions would typically centre on how to streamline the procurement process and obtain a more effective and swift access to imagery for future responses. Despite these discussions, which would intensify after every crowdmapping activation, and the development of various initiatives such as Imagery to the Crowd (where imagery would be purchased by the United States Department of State under specific licences that would allow its use for humanitarian purposes), the process of imagery procurement to OSM contributors was still fraught with delays; e.g., during the Haiyan activation, there were delays of around seven to ten days, and the HOT community still had little direct influence on the release of imagery. At the time, DigitalGlobe was the main organisation providing the resources—namely, satellite imagery. As it possessed resources crucially needed by other actors, DigitalGlobe held power over the HOT community and controlled the imagery procurement process.

The delays with which DigitalGlobe released its imagery to OSM contributors was attributed to a number of reasons that rendered the process less than streamlined. Firstly, the commercial model within which DigitalGlobe operates as a for-profit organisation. Secondly, the sheer number of intermediaries—such as Humanitarian Organisation One, HIU, and Mapbox—that were involved in most of the communication that took place between HOT and DigitalGlobe. Thirdly, the weather conditions prevalent in the immediate aftermath of a disaster could hinder the capturing of clear post-disaster imagery.

The delays, coupled with an unclear release timetable, caused concerns amongst members of the HOT community, with many questioning the domination and power held by DigitalGlobe over the imagery procurement process. This concern and questioning encouraged the community to seek more control over imagery resources, despite the previously launched

initiatives including Imagery to the Crowd. The community were not content with the measures taken by the United States Department of State for the use of satellite imagery for humanitarian purposes, nor were they content with the commercial model within which DigitalGlobe operates. Therefore, the community attempted to assert its influence on the imagery procurement process by launching an online petition that specifically advocated the 'quicker release of imagery' for a 'longer period of time'. The announcement of the petition, which was made in the OSM forum, is shown below:

Dear All,

You know how useful the geodata produced by OpenStreetMap contributors is to help the relief effort in the Philippines after typhoon Haiyan.

This effort could be even more efficient if more imagery sources had been made available more quickly, and for a longer period of time, especially considering the magnitude of this crisis, and the time that will be needed to recover.

So a petition has been setup, to give a way for the public to show its support to this request.

https://secure.avaaz.org/en/petition/All_satellite_imagery_providers_Philippines_open_the_satellite_images/share/

Please sign it, and let the people around you know that they could do something useful for the Philippines, and for the victims of future major disasters, with a contribution as easy as a signature.

Best wishes,

Figure 29 - The call for petition in the OSM forum (OpenStreetMap, 2013a)

The request for the imagery to remain available for a 'longer period of time' was the result of a misunderstanding between actors; the HOT community wrongly assumed that access to the satellite imagery would only be granted for 30 days, after which it would be withdrawn;

"what we initially thought and what had kind of been reported was that there was this 30-day limitation, so we thought, 'Well, that's kind of a dumb thing to do, I mean we might be six months from now and they will still be rebuilding and what if we find some area that we missed and we want to go back and handle this'. So, we thought, 'Why do we have to be limited to these images and this 30-day window?'" (HOT Activator).

This had sparked the petition, which was not well received by the imagery providers and even by large sections of HOT;

"and then it came out, later, that, 'What we mean is that, for 30 days, we will grant imagery requests for new imagery, but the existing requested imagery that we have put up will still be available.' That was a big source of the animosity too with this petition

and whatnot, because we kind of misunderstood what was meant by that 30-day issue. It was, like I said, a big misunderstanding on both sides and so it just kind of spiralled from there” (HOT Activator).

Once the petition had been launched, differences of opinion in regard to the method of protest manifested themselves within the HOT community, with some supporting it and some not; this demonstrated the diversity of thoughts and opinions, and the tussle between action and control which exist within crowdsourcing communities. Moreover, despite not being backed by the entirety of the community the petition had ended up nevertheless being associated with it;

“well, I don’t know about humanitarians (sarcastically) putting together the petition. It was someone within the OSM community, who also gets involved with HOT responses, who was frustrated with the pace at which imagery was being released, because it ended up taking a bit of time”.

In terms of how the effects of the petition unfolded, a HOT Activator, who had not only signed the petition but whose name appeared in the actual text, remarked on the unintended tension it created amongst the actors involved in the imagery procurement process. The Activator stated that the petition;

“caused some issues, it kind of ruffled some feathers behind the scenes, because there are a lot people who have stuck their necks out to get us imagery and to help us and those people kind of took it the wrong way and they did not like this. It wasn’t so much that it bothered them personally, but what happens is that you have institutions that donate imagery, and then this petition gets circulated calling for more imagery and it looks like the institution has screwed up or that the institution is attracting bad press and so, for the people that already kind of put their jobs on the line to help us out, it was kind of a slap on the face. There was just a lot of bad blood between us and some of the groups, and it wasn’t meant to be that way, but it just was the nature of these things; sometimes they don’t go the way you want them to”.

Another Activator remarked that;

“I think it somehow ruffled a lot of people and concerned some imagery providers, because some of the opinions were asking them to provide us with this kind of imagery, and it is not really their mandate to give us that imagery. It was like we were somehow demanding, the petition somehow demands them to do such and such; but this is..., some people believe that they give it out of charity, out of concern but not really, it’s not really for us to demand from the imagery provider’s access to the data”.

One reason why some found the petition demanding was the way in which it was worded. The following excerpt, although acknowledging the role played by the International Charter Space and Major Disasters, goes on to say that it had not done enough to save lives and help in reconstruction.

We want to thank the members of the International Charter Space and Major Disasters, who contributed to supply for free pre- and post-disaster images. Unfortunately, this is not sufficient to answer diligently to such humanitarian crises and:

1. save lives with a rapid response as soon as such crises happen
2. support the colossal reconstruction effort afterwards.

Figure 30 - Excerpt from the online petition (AVAAZ.org, 2013)

Furthermore, the timing of the petition was not very favourable, as it was launched while HOT and other actors were involved in discussions pertaining to the acquisition of the imagery. Once more, this emphasised the struggle between action and control within crowdsourcing communities, and placed a strain upon the ongoing discussions;

“it wasn’t very strategic to have a very public petition, a demanding petition, which aligned itself with HOT and OSM, where, at the same time, we were having discussions and having people that were working hard on it” (HOT Board Member).

This portrayed the HOT community in a somewhat unprofessional light;

“yes, we all want imagery, but we understand processes are in place, and the petition is not helping the work that is going on. The petition just makes us look like a bunch of unruly, anarchic mappers, which we are. But when you get into that kind of situation you hope that we can talk amongst ourselves reasonably, and it didn’t happen” (HOT Board Member).

The HOT Director also commented on the negative sentiment caused by the petition;

“I think this petition—sort of—was a slap; like, there is no way in hell that the imagery providers are just going to put all their data online, open access for free. It costs two billion dollars to launch a satellite and that money doesn’t recoup itself; like, it’s not happening, the economics don’t work. So, like, being kind of unrealistic like that just made the OSM community look dumb, instead of sort of being, like, good partners”.

Humanitarian Organisation One also distanced itself from the petition. A Geospatial Architect & Developer at Humanitarian Organisation One who was involved in the discussions argued that satellite imagery is not a human right and that, as imagery providers are aware of their social responsibilities, the commercial model within which they operate should be respected. He further remarked that;

“for me, it is a little disheartening; I wish people had focussed less on the petitions and more on the work itself”.

Those in favour of the petition attempted to place pressure on DigitalGlobe to release their imagery. They viewed the petition as a means through which the HOT community could reduce its dependency on imagery providers and take more control over resources. The data collection phase of this study highlighted that the HOT community members, regardless of whether they had or had not supported the petition, had done so without fully appreciating or being able to comprehend its potential consequences. Where there was a notion that the petition could cause damage, a decision had to be made; on one hand, this was a way to potentially empower the HOT community, but, on the other hand, such an initiative could harm relations. Essentially, not everyone within the HOT community had an understanding of the processes that are involved in obtaining satellite imagery. Whereas OSM contributors were well aware of the personal time they had dedicated to crowdmapping during Haiyan, most of them were not very familiar with the procedures involved in obtaining imagery.

Importantly, the aftermath of the petition saw change in the realisation that the imagery procurement process had to be streamlined and improved upon; thus, the clash over resources came to an amicable conclusion.

6.2.2 The Testing of UAV/Drone Imagery: The Diversification of Imagery Procurement

Whilst the effects of the online petition were unfolding, the HOT community undertook a complementary move aimed at bringing about change in the imagery procurement process, tackling its dependency on imagery providers and increasing its control over resources. During the last few days of the Haiyan crowdmapping response, the HOT community tested imagery obtained through UAVs to explore its suitability for OSM. The test was important as the HOT community was beginning to realise how such imagery could benefit its crowdmapping efforts. Essentially, the positive results of the testing phase provided the HOT community with a complementary source of imagery that could be collected by them and that they would own, rather than having to rely solely on satellite imagery providers; in this instance, economic factors gave the HOT community the option of actively controlling the source of imagery—i.e. having ownership of relatively inexpensive UAVs, as opposed to very expensive satellites. Importantly, the testing phase brought about a change in the idea of imagery procurement, in that the HOT community would be henceforth able to develop and own its own resources. It should be noted that UAV imagery is to be viewed as a complement to that captured by satellite and not as its replacement, as the two formats present their own specific advantages and disadvantages.

To highlight the positive results of the testing period, a HOT Board Member advised that the community is now looking at different ways in which it can gain better access to UAV imagery, to enable crowdmapping based upon it. This has led to the re-launching of the OpenAerialMap project, which, as described by a HOT Board Member, is;

“a system for allowing people to share aerial imagery . . . we believe that it will be particularly useful for small patches of imagery coming from drones . . . so it is taking away some of the technical barriers that people have for sharing imagery. You don’t necessarily need to understand all the technicalities behind the rectifying of the imagery and you don’t need to have your own servers to scale to serve up imagery if you can get it onto OpenAerialMap, which is the idea”.

To re-launch OpenAerialMap, HOT recently received a grant from the Humanitarian Innovation Fund; in essence, the project would provide the infrastructure that would enable

the sharing of imagery from complementary sources. With regard to the ongoing process aimed at determining how imagery from UAVs could prove beneficial for OSM, a HOT Board Member advised that;

“we intend to work in policy around drones, because there are considerations you need to make, we spend a lot of time when we are doing mapping situating ourselves within the local context, understanding the local communities and explaining what we are doing, making sure that what gets collected and produced is shared back and that same kind of consideration is needed with drone imagery and as it is a newer thing for us, we need to think it through”.

Furthermore, the HOT community’s acceptance of UAV imagery has been followed by that of humanitarian organisations, therefore, at the organisational level. Humanitarian Organisation One is also looking into UAVs; this is serving the purpose of legitimising them as a source of imagery and giving increasing value to the number of groups involved in their development. An avid community is developing, with various events organised worldwide; one such is Drones for Good, which sees UAV developers competing against each other. Importantly, the UN OCHA recently published an important policy document on the use of UAVs in the context of humanitarian response, further legitimising them as a complementary source of imagery. This document is important as it recognises the increasing role played by UAVs in civilian tasks as the technology becomes more mainstream. It further acknowledges the use of UAVs for mapping, data collection, situation monitoring, search and rescue, and public advocacy and information by humanitarian organisations. This report could potentially serve as a way of formalising the avid community and providing it with greater organisation.

The exploration of complementary sources of imagery for the humanitarian response sector also has wider implications; the recognition gained by both the community and organisational levels could herald the beginning of the democratisation of imagery for the sector. The argument has also been made that the proliferation of UAV technology will assist not only remote crowdmapping, but also the contributions made by the local disaster affected communities, empowering them and, essentially, enhancing their agency. As articulated by Patrick Meier, it will enable the local affected communities to;

“operate their own UAVs and capture imagery themselves, and be the source of aerial imagery for humanitarian responders”. He further stated that *“I think this a positive element, make them producers rather than just consumers”.*

Importantly, as had the effects of the petition, the testing of UAV imagery by the HOT community further reinforced the realisation that the imagery procurement process had to be changed by, essentially, streamlining and improving it. The HOT community’s exploration and testing contributed to a change of domination in the field of imagery procurement, which is explored in the next sub-section.

6.2.3 The Imagery Coordination Group/Tool

This sub-section presents the evidence that shows how, in the aftermath of Haiyan, the imagery procurement process has changed. The imagery providers’ domination or control over resources has been reduced by the development of the imagery coordination group/tool, which has given the HOT community greater access to satellite imagery resources. After Haiyan, all actors shared enhanced meaning about the imagery procurement process needing to be improved and streamlined; this realisation was reached through the contribution of the online petition and of the testing of UAV/drone imagery.

A Geospatial Architect & Developer at Humanitarian Organisation One stated that, in the aftermath of Haiyan;

“we realised that, with all the different organisations now involved in these sort of situations, there needs to be a coordination tool, and that’s where the coordination tool came about”.

Reflecting this state of affairs, the development of the imagery coordination tool/group aimed at dealing with the control held by imagery providers, with all actors, including DigitalGlobe, showing willingness to participate in it. Whilst the imagery will still be held by the providers, the procedures have been vastly improved to help overcome the issues that had previously been faced, resulting in greater access. The imagery coordination tool or group, has established stronger direct links not only between HOT and satellite imagery providers, but also with humanitarian organisations such as Humanitarian Organisation One.

A HOT Activator advised on the changes taking place in imagery procurement, stating that the imagery coordination tool/group;

“came out of the Haiyan activation, because of the kerfuffle surrounding imagery . . . we decided we wanted a better process for that; both for us, to get imagery more quickly but also just to avoid causing problems for our partners”.

Specific requests can be made by HOT, who can now draw any specific map area and request imagery for it. The imagery providers will receive such requests and appropriately supply the imagery for the specified area or provide details as to when it will be available. This has been coupled with the development of a small closed membership email list which includes HOT and imagery providers. When imagery will be requested, the listed members will be notified through email and the imagery providers will respond to state whether and when they will be able provide the required imagery. Not only will this streamline and quicken the entire process, but it will also avoid the undertaking of duplicate efforts by imagery providers;

“I think what’s going to change is that the procurement of the satellite imagery is going to get a lot faster and a lot easier” (Open Data Expert, Mapbox).

This development has significantly improved imagery procurement; before the launch of the tool/group, actors would make duplicate requests, which would irritate imagery providers, and there would be no understanding of which requests were more urgent.

The tool/group in itself is not a definite threat to the dominance or control held by imagery providers; rather, it is a way to work around it. A true democratisation of imagery will not become prevalent until more satellite imagery providers will decide to share their imagery. Furthermore, the satellite imagery providers have become aware of the benefits linked to providing imagery for humanitarian response, in what is, in fact, a win-win situation for all actors. Whilst OSM directly benefits from the imagery, the imagery providers have the opportunity to showcase how their products are being used for the greater good. Importantly, those who hold the power in this relationship—namely, DigitalGlobe and Airbus—are showing increasing support for such humanitarian ventures. Highlighting this, a Product Manager for DigitalGlobe stated that they;

“support OSM’s want and sentiment to get things faster because in the end what they’re trying to do is help save lives on the ground and help give aid to people on the ground”.

The inter-relationship between the groups involved in the imagery coordination has also been improving, thus increasing the speed at which HOT can access the imagery. For example, raw satellite imagery has to be processed before it is actionable by the crowdmapping community; DigitalGlobe and Mapbox have been strengthening their ties and a new partnership was recently announced giving Mapbox access to the imagery, which, after processing, they can then provide to OSM. This is an important partnership because, as advised by an Open Data Expert, Mapbox has the capability to process and publish imagery faster than DigitalGlobe. Once they have received the imagery from DigitalGlobe, they can have it ready for OSM in the required format (tile server compatibility) within a few hours.

This imagery coordination tool/group has been working very effectively in post-Haiyan HOT activations, including the response to the Ebola crisis. A Geospatial Architect & Developer at Humanitarian Organisation One stated that;

“it has proven wildly successful, for Ebola for example. We talked about it in I think maybe February or March and we use it a lot”.

A further example of its success was highlighted by the HOT Director who stated that;

“it’s been a lot more effective to coordinate things between everyone. We were able to get certain imagery at no cost through the imagery coordination group . . . We were able to get it free and, actually, probably in a timelier manner than going through a purchasing process”.

Furthermore, a HOT Member detailed how it has been beneficial;

“I would say just defining where the communication happens and making sure it’s in one place and that everyone that needs to be made aware of it knows. It’s worked really well for the Ebola response”.

Also, as highlighted by a Geospatial Engineer at the Canadian Armed Forces DART, the development of the imagery coordination tool/group;

“was definitely a great success . . . it was a great success on everyone’s part . . . I think everyone has gotten better after this disaster (Haiyan) so that, the next one, we would be even more ready”.

6.2.4 Summary

This section details the challenging of domination by the crowd in regard to the imagery procurement process. Through the key intermediaries that contributed to a power shift—namely, negotiations (involving an online petition), and the exploration of imagery sources, OSM contributors were able to obtain greater access to satellite imagery, reducing the control exerted by imagery providers such as DigitalGlobe, over the imagery procurement process. The section also provides the evidence of the change in the imagery procurement process—namely, the development of the imagery coordination group/tool, which has given the crowd greater access to satellite imagery resources. This understanding of the crowd, as an entity that can take certain actions that can contribute to a power shift, differs from what the existing literature suggests—e.g. Allahbakhsh et al. (2013), Hansen et al. (2013), Kittur et al. (2011), and Yung et al. (2014).

6.3 Legitimising Crowdmapping for Humanitarian Response

This section highlights how crowdmapping has become legitimised within Humanitarian Organisation One, for their humanitarian response efforts. It details the key intermediaries (quality control and humanitarian technological development) that have enabled this legitimisation, which is made manifest by the technological investment into crowdmapping made by the organisation. Humanitarian Organisation One’s technological investment has been both internal and external; internal with regard to investing into technologies aimed at better leveraging crowdmapping for humanitarian response, and external with reference to investing into the utilised crowdmapping system—namely, OSM. Importantly, this legitimisation has established new norms within Humanitarian Organisation One in regard to their humanitarian response efforts, with crowdmapping now becoming part of these efforts.

The intermediaries that enabled the emergence of the legitimisation of crowdmapping within Humanitarian Organisation One essentially related to the HOT community practices demonstrated through the tasking manager, and the environmental practices demonstrated through various humanitarian technological developments.

6.3.1 The HOT Tasking Manager: Controlling the Crowd

OSM's quality control procedures and the technology surrounding them have been key in enabling the accurate and effective use of OSM crowdmaps on the ground, which, in turn, has contributed towards crowdmapping for humanitarian response becoming legitimised within Humanitarian Organisation One.

OSM's quality control processes are undertaken by the more experienced contributors, who check map edits against the instructions of a task laid out in the tasking manager. If problems are found with an edit, an experienced contributor will fix it, or mark it as needing to be redone. If no problems are found, then the edit will be marked as verified. A GIS Officer at Humanitarian Organisation One stated that;

“the HOT team do have a validation process . . . they have people that do the initial data collection or digitisation, and then they have more experienced volunteers who come in and do validation, so we pretty much rely on what they do”.

This highlights how Humanitarian Organisation One trusts the crowdmapping practices of the HOT community to the extent that they themselves do not have specific mechanisms in place to check the quality of crowdmapping.

Furthermore, mapping rules are mainly articulated, both tacitly and explicitly, through the tasking manager. If contributors do not follow those rules, they are sanctioned and their edits are changed or altered to conform.

In essence, the HOT tasking manager is a technological component essential in controlling the contributors' crowdmapping output; its use in practice contributed to the legitimisation of crowdmapping for humanitarian response within Humanitarian Organisation One.

6.3.2 Mapathons: Training the Community

Training, as an important part of quality control, has also been key in enabling the accurate and effective use of OSM crowdmaps on the ground. Contributor training is mainly achieved through mapathons, which provide HOT with an alternative way to instruct contributors in regard to the rules of crowdmapping. Furthermore, many mapathons are conducted in liaison with Humanitarian Organisation One; these have enabled Humanitarian Organisation One to impart their crowdmapping rules to the HOT community.

Looking at one such mapathon in more detail, Humanitarian Organisation One worked closely with George Washington University (GWU), United States, where, for the Haiyan activation, GIS systems students participated in mapping sessions, which served two purposes. Firstly, the GIS class students were able to put their theoretical knowledge into practice and, secondly, the maps of the affected areas were being populated. The students were being taught about the importance of open-data and where it could be used, and, to give them some practical experience, they were trained on OSM. This practical training would be provided in the context of whichever activation was on-going at the time of training. For example, previous classes had worked on crowdmapping areas in South Sudan, where there had been warnings of a cholera outbreak. When Haiyan struck, over 100 students at GWU had already been trained on OSM, and Humanitarian Organisation One contacted the University, asking them to undertake mapping. In total, the students at GWU undertook mapping and validation tasks for around a week.

Explaining the dynamics of the mapathons, a GIS and Cartography Academic at GWU stated that;

“we sent out emails to students from former years and said, ‘Look, every lunch time for two hours for the next week, we will be meeting, the department will pay for lunch . . . come in and help us map Haiyan.’ So, rather than it being one big 100 people session, which usually we would have in conjunction with the class rooms, the Haiyan mapathon was kind of strung out over a week, whereby people would show up, hang out, have lunch, like a lot of faculty did too. They would just bring their lunch into our lab and everyone would hang out, we would put on some tunes or whatever, people would talk and we would work on whatever tasks”.

The GIS and Cartography Academic also expressed how students were more enthusiastic to participate in the Haiyan activation than in others—e.g., the South Sudan one—as they had greater knowledge of how crowdmaps were actively being used on the ground during a humanitarian response;

“so the fact that it was getting used, they were even more excited, they were excited that they were participating in disaster response, like the data was going to be used for modelling, for plans, but then, when it came to Haiyan, it was also this immediacy, and,

when I came back in the Spring, to be able to, like, show them photographs of people that I worked with in the field, holding tablets . . . they felt part of it, you know. Me and my mates helped do some of this stuff and it was actually getting used, you know it had the coolness factor to it”.

This highlights the importance of contributors being aware of how crowdmaps are being used on the ground, as this awareness can further galvanise them.

6.3.3 MicroMappers, Verily and AIDR: A Digital Humanitarianism Environment

The continuous evolution and development of technology for humanitarian response has also played a role in bringing about the legitimisation of crowdmapping for humanitarian response within Humanitarian Organisation One. Although this organisation made more use of OSM crowdmapping than of other technologies, the generally positive environment created by other technological developments helped in this. For example, a positive environment was created and extensively promoted through the widespread coverage of the use of other humanitarian technologies—including MicroMappers, Verily, and AIDR—during the Haiyan response.

In a wider sense, these technologies are lightening the burden placed upon humanitarian organisations and the crowdmapping community. Importantly, the recently developed MicroMappers, Verily, and AIDR technologies have attempted to deal with the challenges presented by big data during humanitarian responses. MicroMappers and AIDR work in parallel with Twitter, which, as argued by many, found itself being used for humanitarian response ‘by accident’. Tools such as MicroMappers, Verily, and AIDR have been developed to deal with the specific challenges faced by humanitarians in attempting to make sense of the overload of information made available in humanitarian response by the use of social media tools such as Twitter. These tools are important, as having to deal with too much information can have the same paralysing effect as having to deal with too little information.

In essence, the more humanitarian organisations engage with technologies developed for humanitarianism, the more these technologies will potentially increase the legitimisation of crowdmapping for humanitarian response in general. So, just as the technological underpinnings of OSM enabled the accurate and effective use on the ground of OSM crowdmaps by Humanitarian Organisation One, other humanitarian technologies are

increasingly being used by humanitarian organisations—e.g., during the Haiyan response, MicroMappers was used by Humanitarian Organisation Two. Importantly, as humanitarian organisations do not operate individually in a vacuum, the increasing use of dedicated technologies creates a positive digital humanitarianism environment within which all organisations can operate.

6.3.4 The Technological Investment into Crowdmapping

This section details the emergence of the widespread legitimization of crowdmapping for humanitarian response within Humanitarian Organisation One, which materialised post-Haiyan and is made evident in two main ways. Firstly, Humanitarian Organisation One is investing internally into technologies aimed at better leveraging crowdmapping, and, secondly, it is investing externally into OSM, specifically through the HOT tasking manager. The decision to invest in the technological capabilities of OSM was only made in the wake of the legitimization of crowdmapping within the organisation, and what it can do for their humanitarian response efforts. Importantly, new norms have been established within Humanitarian Organisation One in regard to its humanitarian response efforts, of which crowdmapping has now become a part.

6.3.4.1 Internal Investment: Enhancing Capabilities

A GIS Officer stated that Humanitarian Organisation One no longer doubts the validity or even the quality of crowdmapped data; rather, the organisation's attention has shifted to how to best incorporate crowdmapped data into its practices and how to maximise their effectiveness. As a demonstration of the legitimization of crowdmapping for humanitarian response, Humanitarian Organisation One has realised that it needs to further develop its own technological capabilities to make them capable of supporting the real-time evolving nature of crowdmapped data. Currently, the organisation knows how to hand offline OSM crowdmaps over to its field responders, but this does not enable the real-time, continuous updating of those maps on the devices carried on the field by these responders. In those instances, in which updated maps can be pushed, with the current technological capabilities, this can only be done by sending out large, wholly updated map files, rather than just the map updates;

“I think that we learned that we need to develop better technical tools to work with OSM at that scale and, this way, like, we have been focussing a lot on drumming up the money and the coalitions, we need to work better with the field, we need our field responders to better understand what we do and the possibilities of it because, sometimes, we are just throwing stuff at the wall and seeing what sticks . . . that was one thing that I learned, and we want better technical tools so that we can meet demands better, so we are really working on ways that we can get offline OSM . . . like, we want those tools to be part of what we do and have ways to push them out to our responders and really give them the confidence, give them the best possible thing” (GIS Officer, Humanitarian Organisation One).

This may not seem like a big issue but, in the context of a disaster situation, sending out a 2GB file is just not possible due, among the other contextual reasons, to limited internet connectivity. Humanitarian Organisation One’s technological target is to drastically reduce the bandwidth intensiveness involved in sending out updates. This was articulated by a GIS Officer;

“the mapping technology has come to a place where now we can see the outlines of how that would work; we just need to sit down and knuckle down and do it. We are kind of excited to work that out because I think that it will be a really major advance”.

This engagement with crowdmapping shows how the organisation’s attitude has shifted from mild scepticism to becoming more embracing, in utilising crowdmapping for their humanitarian response efforts.

Furthermore, as highlighted by a Geospatial Architect & Developer at Humanitarian Organisation One;

“we are always sort of looking at new technologies and newer, better, quicker ways of doing things”.

The increasing proliferation of crowdmapping platforms has given Humanitarian Organisation One further stimulus to pursue such ventures to better capitalise on the capabilities that crowdmapping for humanitarian response affords. The Haiyan response proved to be a

milestone for the emergence of the legitimization of crowdmapping for humanitarian response, which has enhanced its technological capabilities;

“so, we are going to major donors now and asking them to support projects where we heavily leverage OSM and where we develop tools for OSM” (GIS Officer, Humanitarian Organisation One).

6.3.4.2 External Investment: Redevelopment of the HOT Tasking Manager

In terms of the investing into OSM, the realisation of the improvements that could be made to the tasking manager took shape over time, but was translated into action by the limitations of the tasking manager made evident during the Haiyan response. Highlighting some of the identified limitations and subsequent improvements, including the ability to prioritise tasks according to urgency, the GIS Officer stated that;

“we couldn’t prioritise tasks; now, when you have tasks on there, you can have high, urgent, medium. What we found was, sort of, that, whatever task was on top, tasks would just get dropped on it sequentially and people would just take . . . so there wasn’t, like, a clear system for assigning things, and also even within a task, even, for example, for Tacloban tasks, I wanted the inner city mapped first, but people were nibbling at the edges”.

The most recent version of the tasking manager is a complete re-write that includes new features, including support for tasks independent from predetermined grid squares. This makes it possible to divide cities into neighbourhoods, resulting in a more detailed and natural mapping experience. Further improvements include user-interface and user-experience enhancements such as layout changes, easier contribution workflows, anonymous access, and translations. Since these changes have been implemented, the tasking manager has become more responsive to individual details.

Also, tasks can now be secured with passwords and assigned to contributors based on their skill levels; as was highlighted by a GIS officer, this ensures quality of data, as the more complex tasks can be assigned to the more experienced mappers. Importantly, this has made the contributors’ mapping experience more worthwhile as they do not become overwhelmed by tasks that might be too complex for them—or, in fact, so easy that they do not challenge

them at all. One instance in which the need for this improvement was made evident involved the crowdmapping of details from old United States Army maps. Those maps, the data from which was licensed to be imported into OSM, contained the names of numerous places that would otherwise have been quite difficult to locate. The technicality involved in this particular crowdmapping activity was that the contributors needed to be aware of how to line up the maps and then check for discrepancies between them and the imagery. Occasionally, during this comparison, the United States Army maps would be found to be a km or so off, an error that could only be spotted by contributors with a certain level of experience.

Before the changes made to the tasking manager, it could only be hoped that the contributor to whom such a task was assigned would be able to accurately complete it. The GIS Officer further stated that;

“it was as much an art as it was a science; and so you really only wanted to do that with, like, trained people that you could trust, because it could result in a lot of crap data otherwise. During Haiyan it was almost like we kind of tried to, like, bury those tasks so people wouldn’t find them and then we could hand pick people, but now we can just lock it and it’s a lot easier. So that’s actually seen a lot of utility in the Ebola response, there has been a lot of technique involved”.

Furthermore, when a Geospatial Architect & Developer at Humanitarian Organisation One was asked about the improvements made to the tasking manager, he stated that;

“well, we helped fund the tasking manager improvements so I think they are awesome (laughs). It just makes things much easier, that’s the constant sort of ethos of this, we are never satisfied with the tools, and we are never satisfied with the quality of the map, so we are just going to keep advancing those over and over”.

Humanitarian Organisation One’s substantial levels of investment, both creative and financial, into the tasking manager are evidence of the legitimization of crowdmapping within the organisation, for their humanitarian response efforts.

6.3.4.3 New Crowdmapping Conditions: New OSM Contributor Practices

The OSM contributors with whom this study conversed articulated their thoughts on the new version of the tasking manager, confirming the investment made by Humanitarian Organisation One.

Nearly all the contributors stated that they were pleased with the changes that had been made because they improved their crowdmapping practices. A contributor expressed this by stating that;

“now it’s better. Now it’s much better than in the old times”.

When further probed as to why it was much better, he stated that;

“so, they were working really hard on this because there were some technical problems because, when a lot of people connected, it just fell down or... I don’t know, something like this. So, there were some technical issues with the tasking manager and that was the reason they tried to move on with a new version”.

This highlights that the technical issues that were causing the tasking manager to crash were dealt with through its redevelopment.

Other contributors got more involved in the improvement process by suggesting changes that could be made;

“it had some aspects, I think, that they could improve, and I actually suggested this. Some of them were more or less done or almost done, and others not” (OSM Contributor).

One of the suggestions made was that the tasking manager would have benefitted from a message board type facility that would enable contributors to leave messages for those tasked with validation; the overall communication amongst contributors would have been benefitted by such a facility. When it was added, the feature was well received by contributors;

“I really like the new feature that you add a comment that everybody can see after you locked and unlocked a task, and I don’t remember that this was there during the Typhoon, and I think that’s a very, very important thing because, for some tasks, you

cannot do anything because you have heavy cloud coverage and it is still marked not done . . . I think that is a very good improvement of the tasking manager” (OSM Contributor).

Overall, significant changes have been made to the tasking manager, with Humanitarian Organisation One playing a major role in this redevelopment. As mentioned, an important change has involved the support of non-grid square based tasks. A number of contributors expressed that they had previously sometimes found mapping squares to be too difficult and too big a task. They went on to say that non-square task support represented a big step forward. A contributor voiced that;

“the first time I saw it (the tasking manager), it was squares only, now there are smaller squares, there are different sizes, that’s a big improvement, I would say. Sometimes, it was just too big to do one of the squares on your own”.

Another contributor reaffirmed this point, expressing that the new tasking manager;

“did have some improvements . . . especially the split tile thing, if I remember, the one where sometimes a tile covers hundreds of buildings and you’re thinking ‘Oh no, I’m going to spend three hours doing this’, and then you’re going to hog the tile for three hours. Instead of doing that, you can simply break the tiles down further, to four quarters for example, and just select one of those instead. So you can technically bring down the task down to 25% of the original size”.

The reduction of mapping conflicts made possible by the new tasking manager was another feature that was commended by contributors.

In essence, the redevelopment of the tasking manager has been quite significant, resulting in new crowdmapping practices for OSM contributors. These practices were aptly articulated by a contributor and Geographic Information Specialist at USAID;

“I think it’s just kind of easier to use. Some of the wording is simpler. I think there is more customisation of the area you want to do and how big the squares are and things like that . . . it has more statistical things, like how much change has there been over time. Like, there is the chart that shows how much has been completed and how much has

been validated. It just is kind of easier to use . . . like user interface improvements . . . It's a lot better post Haiyan . . . there is also a priority thing on it, like is it a high priority task, low priority task . . . there is different levels of users, it used to be that you are just a user or a manager person, now its different tiers, so someone who can make a task but can't really edit things and stuff like that. So I think there is more customisation".

6.3.5 Summary

This section details how crowdmapping has become legitimised in humanitarian response through a number of key intermediaries including quality control and humanitarian technological development. Similar to the evolution of the meaning of crowdsourcing, the legitimisation of crowdsourcing has emerged over time and not in a sudden or surprising manner. The section also provides the evidence of the legitimisation within Humanitarian Organisation One—namely, internal and external technological investment; internal with regard to investing into technologies aimed at better leveraging crowdmapping for humanitarian response, and external with reference to investing into the utilised crowdmapping system—namely, OSM.

6.4 Critical issues Facing the Crowdmapping Community

Despite the quality control procedures implemented, a number of critical issues still face the HOT community. It is important to highlight these in light of Humanitarian Organisation One's creative and financial investment into OSM through the redevelopment of the tasking manager, creating new crowdmapping conditions for OSM contributors.

During the Haiyan crowdmapping activation, OSM contributors expressed concern in regard to four main issues. The more experienced mappers, who were undertaking quality control, were unaware of how accurate the edits needed to be; e.g., if a building was not mapped on its exact location, the contributors would speculate with regard to how small the error would have to be to be acceptable. Furthermore, the contributors were not clear regarding the mapping of the specific local context by means of the satellite imagery. A large number of the contributors were not based in the Philippines; therefore, they found it difficult, for example, to identify some buildings as such from the satellite imagery. Also, a large number of contributors was unaware of how the crowdmaps were being used on the ground by

humanitarian organisations. A further critical issue related to the lack of feedback given to contributors with regard to their general crowdmapping practices.

6.4.1 Validation Procedures: Ambiguity around Crowdmapping Accuracy

Looking at these inadequacies in more detail, the validation or quality control procedures generated ambiguity and uncertainty amongst contributors, to the point where some were uncomfortable with undertaking validation tasks. This was due to the fact that HOT had not laid out exact guidelines on how to effectively carry out these tasks. Despite being conceptually aware of the process involved in validation, uncertainty and indecision plagued contributors as they were unsure of how accurate they were required to be. For example, one contributor stated that;

“what do you do if somebody has mapped a square and, say, there are 200-300 buildings in that square they have mapped, and they have missed, say, five buildings, what do you say about that, what level of omission becomes that this is unsatisfactory, is even one building missed unsatisfactory?”.

This emphasised the uncertainty that troubled contributors in the use of the OSM’s validation features. Another contributor further emphasised this by expressing;

“I would basically just come and look and see if the buildings were there and if they looked good, and, if not, I would change them a bit myself. But . . . I wasn’t sure of the actual, like, rules or guidelines for that”.

This underlines how some contributors defined their own accuracy specifications, even though uncertainty clouded their judgment. This was more precisely articulated by another contributor, who stated that;

“if it was within a few metres, I didn’t change it because... well, especially when you start to map almost from scratch, then it is more important that a usable map is being shown up, to get accuracy down to within three to four metres”.

Therefore, to make sense of or justify these accuracy specifications, contributors would look at the bigger picture linked to the development of a usable crowdmap. Despite this, because

of the lack of instructions, some contributors were unenthusiastic about the validation process. In particular, a contributor indicated hesitation;

“I mean, I have to say that I felt uncomfortable, and I don’t think I actually ever did say that ‘This isn’t good enough’, or in some way, I can’t even remember how one went about as marking something as not being satisfactory, but I would have felt uncomfortable to do that to another mapper, unless it was absolutely atrocious and they were taking the mick”.

When further probed, the majority of contributors unequivocally argued that HOT should provide guidelines or instructions on how to carry out validation, as these would not only improve their personal experience, but also the accuracy of the maps, as what was required of them, as crowd-mappers, would be made clearer. For example, a contributor argued that;

“some guidance should be given. I mean, there is a whole load of things that you learn about in OSM, checking the tagging, not putting too many nodes in, certainly not having unnecessary nodes, roads you know, how accurately do you trace roads. I mean, there is a whole range of various quality things that you could visually inspect, and some guidance would be useful”.

6.4.2 Reading/Understanding Imagery: Ambiguity around Imagery Content

Contributors also expressed ambiguity in regard to the local context of the Philippines; they were not aware of how certain buildings looked like in the satellite imagery. A large part of the crowd-mappers for Haiyan were based in the West and, consequently, were more predisposed to visually understand imagery found in Western countries, such as the United States or Germany. Undoubtedly, the buildings, roads and other infrastructure found in developed countries look different from those prevalent in developing ones. Also, many types of infrastructure present in the developing world are absent in the developed one, and vice-versa. A simple example are slums, of which there are many in the Philippines. In satellite imagery, these often appear joined; therefore, the identification of individual slums presents a major challenge for those attempting to map them. A large number of Western contributors were unfamiliar with such imagery. This was further compounded by the imagery, on occasion, being unclear, cloudy or fuzzy.

The contributors expressed the desire to be given some local context training on what buildings would consistently look like in the imagery. This could be achieved, for example, by means of a simple one-page document or a short tutorial video. This wish was voiced by a contributor;

“having some examples of, maybe, the general types of buildings could help a lot. Having some training so you can see, for example, that’s the kind of typical buildings for... I don’t know, for farms; so you can look at these kinds of buildings and you will know how to map them when you see them again. So, maybe some kind of training samples or samples that are verified by some locals and you can go there and see the data”.

Detailing how this training could be provided, a contributor stated that;

“it would be nice to have either a tutorial video or some kind of set of pictures that shows comparison of how it actually looks like and how it looks like on the satellite imagery and what typical buildings are . . . I think it would be useful”.

Understanding that training materials may not always be made available in advance for all countries, another contributor argued that this could perhaps be done on a more ad-hoc basis;

“it certainly would have helped, there was a couple of things, like, you just do ad-hoc; like, someone was circulating some photos from Flickr that were just photos from the Philippines that give you a bit of an idea. But yeah, just simple examples like an area, an aerial photo of an area and then like a ground level photo of the exact same area, things like that; if we had them, it would really people get going, I think”.

6.4.3 The Use of Crowdmappings: Lack of Knowledge of Crowdmapping in Practice

Contributors expressed their lack-of-knowledge in regard to how the OSM crowdmaps were being used on the ground. Due to the very fact that they were being asked to crowdmap, some inferred that the maps were being used; however, when further probed as to how, they were not sure. They could only accurately name the humanitarian organisations that were making use of the crowdmaps, as HOT, mainly through the mailing list, had disseminated the related information. A contributor remarked that;

“to be honest, I don’t know how they were being used. I know that the aid agencies did contact OSM and asked them to do it, so I did it”.

Other contributors did have a better understanding of the maps’ use, but seemed reluctant to share it openly, because their thoughts had not been affirmed strongly enough. For example, a contributor stated that;

“I do have a general idea but nothing is... there is not a frame, a clear frame on my mind and there was no feedback in my perception and use of time. As a volunteer, I cannot say anything”.

There were also some contributors who were not too interested in how the maps were being used, but assumed that the related information was readily available;

“I actually think that it was quite transparent, but that I just did not inform myself”.

Overall, the general consensus amongst contributors was that the maps must have been having some impact on the ground, otherwise they would not have been asked to carry out the crowdmapping. HOT had sent out some information through the mailing list and some humanitarian organisations had made it available through, among other means, social media. For example, Humanitarian Organisation One circulated some images via Twitter on how the large crowdmaps were printed out onto paper and distributed amongst their field responders in Tacloban. Nevertheless, the majority of contributors articulated that the information had not been sufficiently targeted, which would serve the purpose of further galvanising and motivating them to participate in future activations.

6.4.4 Mapping Feedback: Lack of Knowledge of Crowdmapping Practices

A further critical issue was related to mapping feedback. Contributors who were involved in multiple successive activations did not receive any specific feedback pertaining to their mapping practices, and were therefore unable to gage the quality of their mapping practices;

“I think I can’t say this because I don’t know the reality. So I don’t know if that thing I mapped is as a building or a path, is really a path or a building, or is still existing, so I can say, for me, that I did my best to decide the right thing but I can’t say that if it was really a good job I did or not” (OSM Contributor).

When asked whether they would have preferred to receive feedback on their mapping practices, the majority of respondents were unequivocally in favour;

“certainly, I would love to hear, ‘Oh, hey, yeah, that was great’, or, ‘That was terrible’, I think, yeah, feedback would be good. A little bit of feedback would be good” (OSM Contributor).

In terms of how feedback could be given, a contributor remarked;

“maybe one email or something at the end of the activation to say, ‘Okay, you did this and it was this good’, or something like this”.

Although the validation process could potentially serve as a means to provide feedback, the majority of those interviewed were unable to mention any instance in which their edits had been validated or, indeed, invalidated. Table 16 highlights the critical issues facing HOT.

Table 16 - Critical issues facing the HOT community

Critical issues facing the HOT community
- Contributors being unaware of how to undertake validation procedures.
- Contributors being unaware of how to read/understand satellite imagery.
- Contributors being unaware of how crowdmaps are being used on the ground.
- Providing contributors with feedback on their crowdmapping practices.

6.5 Profile of Crowdmapping Community

Adding to the above section exploring the critical issues facing the crowdmapping community, this section further explores the crowdmapping community, specifically, that of OSM contributors. The areas explored are; eagerness-to-know, motivations, expectations, and humanitarian practices beyond crowdmapping. In essence, this section sheds more light on the actors responsible for populating the product—namely, the OSM crowdmaps, used by Humanitarian Organisation One for their humanitarian response efforts.

6.5.1 Eagerness-to-Know

A large number of the contributors articulated that they wanted to enhance their understanding and know more about how the crowdmaps were being used by humanitarian organisations for their response efforts. As mentioned, HOT did send out some information

on this through social media sites belonging to the humanitarian organisations, but despite this, the majority of contributors stated that they wanted to know more about this.

Despite making an attempt to develop an understanding on how the maps were being used, one contributor voiced that;

“I read a couple of articles about it, but I’m still kind of not sure. I hope right, it was having some effect, I would like to have more information on this, but I think generally the use is to coordinate”.

When asked if they would like to know how the crowdmaps were being used during the Haiyan activation, another contributor emphasised the community based nature of OSM;

“I think not get in touch with me, but with the community. Like tell the community how it is used. Maybe some blogposts or something like this. So I don’t need to get anybody to get in touch with me personally, but with us more”.

Furthermore, this also highlighted that contributors were able to go beyond simply stating that they would like to be advised on how the crowdmaps were being used, to give possibilities on how this could actually be done. For example, another contributor articulated that;

“one of the things would be to have a post-disaster report as to how the maps were being used. But at the same time... just keep it very simple... here is a photograph to show this, this would be more than enough... So it’s better to know that yes, it’s being used... it serves the purpose of informing that yes the maps are being used and it’s also motivating at the same time”.

Also, more surprisingly, another contributor voiced that for Haiti there was considerably more information available which was sent out in a quick and timely manner, and he questioned if this was the case for the Haiyan response. He further stated that he would have liked to have read something on this, and that it was not difficult for HOT to facilitate this.

A number of contributors communicated that having a clearer picture of how the crowdmaps were being used would serve as a further way to motivate them and also others to crowdmap;

“I think it would certainly help for as I said, for motivation”.

This was not only to motivate those that were already involved in crowdmapping, but also to bring new people on board;

“it would be more motivation, maybe to get more people involved”.

Another contributor stated that;

“one of the major motivations of OSM contributors is completeness. The other one is usefulness, what they are contributing is actually useful to somebody”.

Contributors argued that having an understanding of how the maps were being used would allow them to better focus on what they were mapping, as they could be sure that their efforts were being utilised. They explained that this would give them more confidence in their mapping efforts as they would know that they are mapping the correct geographical areas;

“it’s indeed a combination of motivation but also it answers are we mapping the right thing” (OSM Contributor).

6.5.2 Motivations

This section examines in detail the specific motivations enunciated by OSM contributors to crowdmap. Specifically, in regard to the Haiyan activation, contributors expressed the following diverse motivations; previous mapping history, interest in maps, helping others and making a difference, hobby, friendly competition, promoting open-source and free-data, and going beyond monetary assistance.

A number of contributors for the Haiyan activation were already previously mapping with OSM in their home locations and therefore had prior mapping experience. When HOT declared the Haiyan activation, some contributors decided that they could apply previously gained skills and experience to a new geographical location and context. Highlighting this, one contributor stated that;

“well first of all, I was contributing to OSM for my city, Montreal, and then I heard about HOT, the Humanitarian OSM team and I found the idea very interesting”.

There were also other contributors that had been regularly mapping specifically during HOT activations, and therefore history of participation played a role;

“well for me, I have been contributing to the HOT team for a while. Haiyan was not my first participation on that type of activity” (OSM Contributor).

This having been said, notably, the Haiyan activation witnessed a large number of first time mappers, more than any previous HOT activation.

An interest in maps was another motivation that was expressed by some contributors. One such contributor voiced that;

“I have always been interested in maps in general”.

The contributor further stated that he was a regular OSM contributor for his home country, not only so that others could benefit from his mapping efforts, but also because he regularly made use of OSM, for travelling purposes. As mentioned, this is not to say that those with an interest in maps were the only ones that got involved during the Haiyan activation, as many of the contributors were experiencing cartography for the first time.

Helping others or making a difference was one of the most commonly expressed motivations by those contributors conversed with. As previously mentioned, a large number of contributors were not aware of how the crowdmaps were being used on the ground, nevertheless, they assumed that their efforts were having some sort of impact or effect; contributors could just not explain the particulars of how the crowdmaps were being used. As stated by a contributor;

“what motivated me was to be able to help from a distance, because normally you see a disaster somewhere in the world on TV, and you say how terrible it is and maybe do some fundraising but most often that is it. In this situation, I could actually help because I have a lot of mapping experience and I could actually help from a distance to hopefully give a little bit of comfort to the people there”.

Another contributor, when asked as to what motivated him to act and crowdmap, stated that;

“usually because I can do it. I have some time or at least I can choose not to watch TV, but rather just do something and make some difference”.

For some contributors, crowdmapping was a hobby, and a way for them to relax. For example, one contributor expressed that;

“for me, it’s some kind of hobby”.

Another contributor stated that;

“I think that it is a combination of relaxing work or a hobby, and at the same time as I think, I myself, I experience it as being useful to others” (OSM Contributor).

Competition amongst contributors was another prevalent motivation during the Haiyan activation. The technological mechanism that drove this competition was an internet page that displayed the number of contributions that each crowdmapper had made. Contributors remarked that they would often view this page to see how their contributions compared with that of others, and when they were, what they perceived to be as behind others, it drove them on to further map. This also promoted the idea of community, where mapping as an activity can be a somewhat solitary experience. One contributor expressed this;

“one thing that I found quite motivating and I think that other people did as well was Pascal Neis’s page on however many millions of segments have been added and things like that, and everyday looking at the numbers, seeing how many people had contributed... you see all these other hundreds of people contributing and you see the numbers going up you have a sense that you are part of something bigger”.

Other contributors had more direct competition amongst themselves, as they were offline friends, so there was communication beyond the mainstream OSM methods;

“a friend of mine already mapped in Tacloban so we communicated with each other about it. Also, we motivated each other. We motivated each other in the way we had a look at the number of contributions and so it was a little bit funny... it was sort of like a championship challenge between both of us, how many buildings he placed and I placed by myself. So it was like a competition between us to see who could map the most” (OSM Contributor).

Another motivation that was widespread, which also explains more about the OSM community in general, was the idea of promoting open-source and, free and open-data. There is a large open-source community that tends to work on many different open-source projects and this is also the case with OSM, where being involved with other open-source projects influences contributors to also get involved with OSM. One contributor remarked that;

“I just discovered OSM because I like open-source Linux community and projects”.

Another contributor articulated that;

“what has contributed more even is my interest in Linux, open-source, that type of culture”.

The Linux community was mentioned by a number of contributors, and it was further stated by another contributor that;

“I’m a member of the Linux community, so I’m interested in a lot of open-source, pre-software stuff, so I was contributing to Wikipedia before, I was doing some programming, reporting about the free software. So I just moved to the mapping as well”.

Highlighting the importance of open-data, a contributor stated that;

“well I got involved in OSM just for mapping around my area, partly just because I decided that it was important that we have a completely public open-data map. I saw OSM happening and I decided that you know people have sort of a duty to get involved... it’s quite an important open-data project that is worth getting involved in”.

Interestingly, one contributor remarked that;

“I was just randomly browsing the net and I saw this and jumped on it. As soon as I started reading about it, I just felt like it was a great open-source project. It was also because it was with the Snowden thing and all that, after the controversy, so I thought it was important to seek alternatives to Google, Microsoft and all that”.

Finally, a large number of contributors voiced that they wanted to make a difference by going beyond monetary assistance during a humanitarian response. They stated that by mapping, they were making more of a difference, a more tangible difference;

“so obviously when you see that type of destruction you think well what can I do? It’s on the other side of the world so you can donate some money, but then you have all those issues of like where is the money really going and your kind of just throwing money at it and you don’t know, it’s hard to see any impact. Well the great thing with crowdsourced mapping is that you see your impact and it’s quite tangible” (OSM Contributor).

This point was reinforced by another contributor when he voiced that;

“I want to do something to help, and I’m here in the US, and that’s in the Philippines, and I will never get there, but I just don’t feel that giving money is really very useful, a lot of people do that, I’m more of a hands on person”.

6.5.3 Expectations

This section examines the expectations that OSM contributors believed were on them when crowdmapping. When probed on expectations, contributor responses mainly centred on that they had to populate the designated areas specified by the tasking manager, to a high level of accuracy. Other contributors voiced that they thought nothing was really expected of them. Also, some contributors expressed that one of the expectations was to get other people involved. Despite conveying that their mapping practices had to be accurate and according to the task description in the tasking manager, there was still some ambiguity surrounding this, mainly because there was no mechanism in place in OSM, that provided mapping feedback; an identified critical issue.

Mapping accuracy was the main expectation that was voiced. For example, a contributor stated that;

“I think it was pretty much described for every single task what was expected. So basically, there was a description of the task, and I think the expected thing was that you try to fulfil this task as best as you can. Yes, I think that’s what was expected”.

Another contributor correctly identified that there was rules in place in regard to crowdmapping, and that edits may be sanctioned if not accurate enough, through the validation process;

“I suppose there are some qualities or rules, well it’s not only quality but also there is a set of rules that you have to follow to map like the keys or values we can use, well I guess its basic knowledge if you are an editor for a while”.

There was a limited number of contributors that went a little further than just saying they had to be accurate. This was done by articulating that the crowdmapping efforts had to be able to address issues of completeness, and ensuring that the maps were current. In the case of OSM, the crowdmaps could only be as current as the aerial imagery that was used to crowdmap, therefore, again emphasising the importance of quality of imagery. In terms of completeness, one contributor voiced that;

“I think completeness is more important than geometric accuracy. If you are capturing buildings against imagery, if you are half a metre out with the location of a building, it really doesn’t make a difference but if you miss a building, then that is more of a shortcoming”.

The tasking manager was the technological component that guided and defined the mapping expectations. By understanding what the tasking manager required them to do, contributors were able to formulate thoughts on expectations such as accuracy and completeness. For example, a contributor stated that;

“enhancing the data, what was expected, yeah I mean to be thorough with the task that you got assigned through the tasking manager. If you say I will do this, then I have to do it exactly”.

This is not to say that all contributors assumed that something was expected of them, as some clearly stated that they did not think anything was really expected;

“what’s expected from me, I don’t feel anyone is expecting anything, I just do it for pleasure, I mean my possibilities as a human being and my spare time, just the activity with OSM and to put the details into the map”.

Another contributor stated that;

“I think really just whatever it is you can contribute. I didn’t feel like there were a lot of expectations, other than you try to do a decent job”.

Involving others was also one of the expectations that was communicated by contributors;

“the other thing I have to do as a contributor is bring more contributors into this whole thing, and I think this is very important because you can spend let’s say three hours a night to map something, but if you have ten people to do this, then you know, crowdsourcing is all about the crowd” (OSM Contributor).

When the above contributor was further probed on how he tried to involve others, he stated that he spoke to his friends about the crowdmapping initiative and distributed flyers at his university. He further stated that he found people to be really interested in the crowdmapping initiative because it was considered a new way to help and a new way to make a difference, in the context of humanitarian response.

6.5.4 Humanitarian Practices beyond Crowdmapping

This section explores the humanitarian practices of contributors, beyond crowdmapping. From the contributors that were conversed with, it became apparent that the majority of them undertook no other humanitarian work other than crowdmapping, during the Haiyan activation;

“no, only mapping. Just mapping” (OSM Contributor).

Another contributor similarly commented;

“just the mapping”.

This was the consensus amongst nearly all that were conversed with. Furthermore, they stated that they would have most probably not be undertaking any other humanitarian work at all, had it not been for crowdmapping. One contributor highlighted the idea of crowdmapping playing an increasing role in humanitarian response;

“I think people are realising that they can do this. It doesn’t really require a lot of training to do it and then they can do something that they think is helpful, and it often is helpful,

so I think people are kind of getting into that. People who weren't necessarily doing this sort of stuff, so I think it's definitely expanding. People are sort of using existing skills in sort of a new way, for OSM in disaster response".

Furthermore, a member of HOT detailed the technological engagement for humanitarian response;

"a lot of people are interested in this idea of digital humanitarianism and the idea of being able to chip in a little bit to help, using your skills and using the internet".

6.6 Summary of Chapter

In summary, this chapter presents the analysis of the main findings of the study. The findings reveal evolving meaning and the emergence of legitimation within Humanitarian Organisation One in regard to crowdmapping for humanitarian response, and the challenging of domination by the HOT community in regard to the imagery procurement process. The analysis reveals that OSM crowdmapping practices have both impacted and have been impacted by Humanitarian Organisation One in a mutual relationship.

Chapter Seven: Discussion

This chapter presents the discussion of the research findings in eight sections. Section one explores the role of the crowd, while section two explores the increasing role of crowdmapping in humanitarian response. Section three details the mutual dependency between crowdmapping and humanitarian response. Section four illustrates the diverseness of the intermediaries involved in the process of change. Section five explores the complex role played by technology, while section six explores the intrinsic motivations behind crowdmapping participation. The seventh section explores the research findings in relation to other explored theoretical foundations, while the eighth and final section presents the summary of the chapter.

7.1 The Role of the Crowd

The research findings of this study highlight that the crowd played an active role in humanitarian response. This active role has been achieved through different interactions between the crowd and Humanitarian Organisation One. Importantly, the crowd showed an interest in improving their situation and acquiring their own resources. In doing so, the crowd demonstrated the ability to think for itself, outside of the control exerted on it. This can be explained through the concepts of dialectic of control, knowledgeability, and reflexivity.

7.1.1 Dialectic of Control

Essentially, the online petition and the differences of opinion it elicited within the HOT community demonstrated the diversity of thought that can be found in such communities. Although the HOT community does not possess a typical hierarchical structure, some members hold more senior positions than others during activations. For example, during the Haiyan crowdmapping response, there were three activators who drove the activation forward, whilst the more experienced contributors undertook validation tasks. Furthermore, the HOT community has board members who carry out various tasks during an activation; e.g., imagery requests.

As stated, Humanitarian Organisation One was the main organiser of mapathons, while also being the driver, in terms of creative and financial input, of the redevelopment of the HOT tasking manager; it can be assumed that both these initiatives represented ways in which Humanitarian Organisation One could also exert its influence over the crowdmapping process

and, in turn, exercise its control over the HOT community's crowdmapping output. This meant that control of the contributors' efforts was being exercised by two entities; firstly, by the HOT hierarchy, and, secondly, by Humanitarian Organisation One.

When, in an effort to challenge domination, the online petition was launched, the different opinions it elicited highlighted a tussle between action and control within the HOT community. Although the three HOT activators and various OSM technological components—i.e., the tasking manager—were attempting to maintain the quality and reputation of the community by controlling the contributors' crowdmapping practices (to the extent that even malicious content could be taken down through validation procedures), the petition was still able to bypass the perceived control and have an impact on the HOT community. So, although the efforts to control output made by the more senior figures or hierarchy within HOT could, in a sense, cause them to be viewed as the 'gatekeepers' of the community, the petition highlighted the limits of their control. These limitations also applied to Humanitarian Organisation One when, as stated, it attempted to control the HOT community's output through mapathons and, later, through the redevelopment of the tasking manager. The effects of the petition unfolded for some time during the activation, whilst discussions aimed at making imagery available were taking place; although senior members within the HOT community and Humanitarian Organisation One disapproved of the petition, they were unable to control its fallout. The limited control exerted by the HOT 'gatekeepers' with regard to the petition was emphasised by a remark made by the HOT Director, *"I don't think the petition was the right approach"*; despite her position, she could do nothing to stop it.

This finding is in contrast to the existing crowdsourcing literature—e.g. Allahbakhsh et al. (2013), Hansen et al. (2013), Kittur et al. (2011), and Yung et al. (2014)—as the existing literature presents a limited understanding of the agency of the crowd, presenting the crowd as an entity that can be easily steered to undertake various tasks. Control is presented in a somewhat simplistic manner, as something that can easily be exerted, with those the subject of control having limited influence on the whole process. The existing literature does not enable an understanding of the fine line that exists between action and control. As can be seen from the findings of this study, however, this is not the case, as both the HOT community's and Humanitarian Organisation One's hierarchies were unable to exercise complete control despite the aforementioned methods being in place. Despite not having any

particular leadership or interest in knowing each other, the crowd were able to challenge the control exerted on it.

As detailed in the literature review, chapter two, the existing crowdsourcing literature emphasises the overall importance of quality control in crowdsourcing initiatives and details the different ways in which this can be achieved; for instance, Kittur et al. (2011) proposed quality control methods that utilise human intelligence—namely, the map-reduce approach. This is enacted by means of some contributors verifying the contributions made by others (represented through map tasks) and by a voting method whereby a single contribution from many is voted as being the best (represented through reduce tasks). Other methods include combining the best parts of various contributions pertaining to the same task, instead of selecting a single one (represented through reduce tasks). Yung et al. (2014) built upon the work of Kittur et al. (2011) by proposing a crowdsourcing system architecture that enables a new quality control approach enacted by means of evolutionary computing and slow intelligence. Hansen et al. (2013) explored the effectiveness (accuracy) and efficiency (time) of two quality control mechanisms put in place within the crowdsourcing system—namely, arbitration and peer review. Allahbakhsh et al. (2013) classified quality control methods in the two categories of design-time and real-time; design-time methods apply to effective task preparation and contributor selection, while real-time ones deal with expert review, ground truth, input agreement, output agreement, majority consensus, contributor evaluation, and real-time support.

Again, all the quality control methods mentioned are presented in great detail, often with the architecture behind them, which would lead to believe that full control in crowdsourcing communities is achievable; however, the existing research gives limited consideration to any problems that may present themselves in their execution.

Approaching the crowd from a more crowd-action based perspective leads to the theoretical concept of the dialectic of control, which was evidenced in the imagery procurement process. The dialectic of control explicated by Giddens (1984) argues that all forms of dependency offer resources to influence; in this case, the dependency being on DigitalGlobe releasing the imagery, and the resources to influence being the petition.

The clash that took place over resources affirmed that, in every situation, actors possess a dialectic of control or the power to influence, even in the most unbalanced of situations. Essentially, in this case, a community of crowd-mappers took on a powerful global organisation, a leader in the field of high-resolution imagery. The petition's signatories, acting on behalf of the whole HOT community, were able to exert their influence on the imagery procurement process, eventually contributing to the development of the imagery coordination tool/group. Typically, in every activation, the HOT community would be dependent on imagery providers such as DigitalGlobe; however, through the petition, the community was able to exert influence over the conditions of reproduction to bring about the breaking of this dependency. This again affirms the idea that power is never absolute, despite any disparity that may be prevalent in its balance (Giddens, 1984). The HOT community was able to exercise relational power with the intention of getting DigitalGlobe to respond in a prescribed manner—namely, to release imagery more quickly and for a longer period of time. Interestingly, Giddens made reference to communication technologies and to how they had altered power relations; this point is reinforced through the online petition, which, as an altering tool, was essentially launched through communication technologies (Tucker, 1998).

Thus, through the petition and the imagery coordination tool/group that followed it, the HOT community was able to shift the balance of power in relation to the imagery procurement process, and transform the crowd-mapping world in which it operates. Therefore, taking into consideration the crowd's ability to act and exert power, it becomes somewhat obvious that the existing literature on quality control (organisational perspective) pays limited attention to the crowd and may not present an accurate picture of the actual control exerted in crowdsourcing initiatives. Contrary to what is suggested by the vast majority of the literature on crowdsourcing, the crowd is not made up of 'docile bodies' who behave in a prescribed or automatic manner.

7.1.2 The Knowledgeability and Reflexivity of the Crowd

Taking this into consideration, the limitations of the control exerted on contributors by the HOT community and Humanitarian Organisation One hierarchies emphasise the need for an increased appreciation and acknowledgement of the crowd and of the role played by it. The imagery coordination tool/group was a specific outcome of the Haiyan activation, and it followed the online petition that, at the very least, brought about a greater awareness of the

need to improve the imagery procurement process. This explicates that, contrary to how it is portrayed in the current organisational perspective crowdsourcing literature, the crowd is not just some insignificant workforce that can be controlled by means of codified methods; rather, it is knowledgeable, and, as demonstrated by this study, it is an entity that has the desire to develop further, to obtain access to its own resources (UAV/drone imagery) and act for itself; in other words, it does not content itself with being controlled, but it aspires to gain some control of its own. This understanding of the crowd as a knowledgeable entity is consistent with structuration theory, which argues that the production and reproduction of society has to be treated as a skilled performance. This implies that the crowd is, in fact, knowledgeable and aware of the social world around it, not only an active participant but also a key composer of the social world (Giddens, 1984). Whereas responding to the more traditional structuralist school of thought, structuration theory introduced this more liberal idea of the social agent, this study argues for the provision of a similar response to the existing crowdsourcing literature with regard to the way in which it views the crowd; one that defines it as a knowledgeable and skilled composer.

Furthermore, within the idea of agency or action, along with knowledgeability, structuration theory argues for the reflexivity of social agents, which understands them as not only being self-conscious, but also having the ability to actively and reflexively monitor the ongoing flow of everyday social life (Giddens, 1984). This study also highlights the reflexivity of the crowd, in that it was continually able to monitor its position and to take action to improve it; at the time in which it had limited access to resources, it was able to take specific actions to challenge the situation and improve it. As argued by structuration theory, the reflexive monitoring of conduct mainly occurs in a continuous manner, rather than in selective moments; therefore, it would be safe to assume that the petition enacted by the crowd to improve its situation was not an isolated event. Moreover, the online petition had the unintended consequence of triggering animosity and creating tension amongst the actors involved in the imagery procurement process. This demonstrates that, although social agents are knowledgeable and reflexive, and actively produce, reproduce and transform the world in which they live, they are not always in control of their actions or of the related outcomes.

In arguing for the agency or action of the crowd, this study recognises that the balance between action and control should be appreciated in order that, whilst it would be still

possible to implement control methods, it should not be assumed that the crowd's action and creativity can be stifled.

In essence, this study goes beyond a somewhat simplistic understanding of control by arguing that it cannot always be fully achieved regardless of the best efforts aimed at achieving or implementing it. This is argued based upon the dynamics of the HOT community and Humanitarian Organisation One hierarchies, in their attempt to control contributors, which was challenged by the online petition and its effects. The contrast between what is portrayed by the existing literature and the findings of this study raises important questions in regard to the type of control that can be achieved in crowdsourcing communities; in particular, this study doubts whether full control is ever even possible.

7.2 The Increasing Role of Crowdmapping in Humanitarian Response

The research findings of this study highlight the increasing role of crowdmapping in humanitarian response.

The knowledgeability and reflexivity of OSM contributors has evolved them into a community capable of playing a role in humanitarian response. Despite a large number of contributors being unaware of how the humanitarian organisations were using the crowdmaps on the ground (an identified critical issue), contributors demonstrated that they sought a change in this situation. By indicating their eagerness-to-know how the crowdmaps were being used in humanitarian response, the crowd were again able to demonstrate a desire to improve their situation, and not simply be content with the status quo. Moreover, contributors were able to demonstrate a sound understanding of what was required of them; namely, to crowdmap in an accurate manner according to the task description in the tasking manager. It is important to look at expectations, as one normally acts according to what their understanding is of what is expected of them in a given situation. Therefore, the expectations that contributors assumed were on them had a direct influence on their crowdmapping practices. The increasing role of crowdmapping in humanitarian response developed over time, as the meaning of crowdmapping evolved within Humanitarian Organisation One.

Although this study explores the practices undertaken in relation to crowdmapping, by also exploring what was not done in the broader spectrum of humanitarian response, the scope of humanitarianism taking place through OSM contributors was able to be identified. It

allowed an understanding of if crowdmapping systems such as OSM are enabling existing humanitarians to simply contribute in a different manner, or if they are attracting a new type of humanitarian.

By looking at other humanitarian work, a number of conclusions can be drawn, namely, that the crowdmapping practices of contributors is resulting in a new type of humanitarian, the digital humanitarian. The humanitarian that undertakes crowdmapping practices by engaging with the technological properties afforded to them; the fact that the majority of contributors stated that they would not have undertaken any humanitarian work whatsoever, had it not been for crowdmapping, signifies the critical and vital role that technology is playing; as an enabler in humanitarian response. We are witnessing the emergence of the digital humanitarian, the humanitarian who crowdmaps during a disaster situation because of the technology at their disposal and on the most part, as identified by this study, undertakes no other work during a disaster situation.

This signifies that crowd agency coupled with technological developments in the form of crowdmapping systems such as OSM, is allowing for a new movement within humanitarian response, by allowing those to become involved, that perhaps would have not otherwise got involved. It also signifies the decentralisation of humanitarian response. Due to this involvement of new actors, humanitarian response is now shifting towards a new way of doing things, where new actors are increasingly playing a role, including the crowd, digital humanitarian networks, and those digitally empowered communities that have been affected by a disaster.

In essence, this understanding of the role of the crowd and the important role that it can play in humanitarian response through the development of crowdmaps, takes the existing crowdsourcing literature further—e.g. Brabham (2009), Heinzelman and Waters (2010), Majchrzak and More (2011), Palen et al. (2007), Palen and Liu (2007), Savage (2012), and Sutton et al. (2008)—by exploring the more longstanding effects of crowdsourcing.

7.3 The Mutual Dependency between Crowdmapping and Humanitarian Response

The findings of this study highlight the duality present in the process of change in crowdmapping. In the crowdmapping initiative explored by this study, such duality was

observed between the practices of the OSM contributors and those of Humanitarian Organisation One; specifically, it was indicated by the investment made by Humanitarian Organisation One in OSM through the redevelopment of the tasking manager, which, in turn, created new crowdmapping conditions for OSM contributors. Such investment came after the organisation had started utilising the OSM crowdmaps, integrating them into its humanitarian response. This highlights the mutual influence exerted over each other by OSM crowdmapping practices and Humanitarian Organisation One, highlighting the duality of their relationship. It demonstrates that the impact of crowdmapping is not a straightforward cause and effect process.

Notably, the duality highlights the mutual shaping of the respective practices; by developing of the crowdmap, OSM contributors shape the response practices of Humanitarian Organisation One while, by investing, both creatively and financially, in the OSM technological components, Humanitarian Organisation One shapes the crowdmapping practices of OSM contributors.

It can be seen that the duality is mutually beneficial to both the HOT community and Humanitarian Organisation One. The latter is able to exert some influence (as argued in the role of the crowd, section 7.1) over the crowdmapping process; thus controlling the contributors' output and taking delivery of a product suited to its mapping requirements and needs. By means of two control methods—the running of mapathons and the redevelopment of the tasking manager—Humanitarian Organisation One is able to disseminate its crowdmapping rules among the OSM contributors and the HOT community as a whole. Therefore, despite not owning the crowdmapping development process, the organisation is still able to influence and change it. This places Humanitarian Organisation One in a favourable position, from which it is able to have its mapping needs met through what is, essentially, an external partner. This lightens the burden placed upon its own mapping departments, which, before the use of OSM crowdmaps, were required to painstakingly detail the maps themselves; this practice was not very effective, as, understandably, the handful of Humanitarian Organisation One employees could not match the contributor numbers offered by OSM. The HOT community benefits from the redevelopment of its technological capabilities made possible by Humanitarian Organisation One's creative and financial resources. Of course, the redevelopment of technology at any stage can be costly, but the

duality ensures that the financial impact is lessened. Furthermore, the HOT community benefits from the knowledge that its output is tailored to the exact needs of its 'customer', Humanitarian Organisation One, as it is the latter that, to some extent, controls it.

However, having explored the positive aspects of the duality, it is important not to ignore its potentially more negative ones. The mutual shaping of the actors' respective practices, which is a feature of the duality, signals that, to some extent, they are developing a reciprocal dependency that will only intensify over time; as more activations take place, Humanitarian Organisation One will increasingly rely on the HOT community for crowdmaps, while, in turn, the HOT community will rely ever more on Humanitarian Organisation One to redevelop its technological capabilities. This will result in a situation by which any issue affecting one actor will also affect the other. This point is particularly important in view of the critical issues faced by the HOT community, as identified by the findings of this study. During the Haiyan activation, those issues were centred on four main areas:

- 1) the more experienced contributors tasked with quality control had not been instructed with regard to how accurate the edits needed to be; e.g., when a building was found not to be mapped on its exact location, the contributors were forced to speculate with regard to what degree of tolerance was to be deemed acceptable;
- 2) many contributors, who were not based in the Philippines and were thus not familiar with the specific local context, found it difficult, for example, to distinguish what represented a building in the satellite imagery;
- 3) a large number of contributors were unaware of how the humanitarian organisations were using the crowdmaps on the ground;
- 4) the contributors were provided with little, if any, feedback pertaining to their general crowdmapping practices.

The developing dependency requires both actors to ensure that the issues listed above, and any others that may arise, are addressed. Failing to do so may impact both the HOT community and Humanitarian Organisation One.

Moreover, in light of the increasing reliance of Humanitarian Organisation One upon the HOT community, the critical issues being faced by the latter raise questions on its long-term reliability as a mapping partner in terms of the perceived fragility of the whole crowdmapping process; unless those issues are met, the benefits currently provided by the duality could be nullified.

This analysis of the crowdmapping's impact adds to the existing IS structural literature. Specifically, it adds to those sections of the literature that have employed the concept of the duality of structure either in its more original formulation or in its adaptation—namely, that of the duality of technology. Consistently with some previous IS studies, this research details the evolution of signification, domination and legitimation. Some instances of those previous works are hereby provided. Walsham and Han (1993) highlighted the processes of strategy formation and implementation of three computer based IS; they based their study on the duality of structure and explored how structures of signification, domination and legitimation were reinforced or modified, finding that structures of domination were continually reproduced, resulting in compromised system effectiveness. Karsten (1995) examined the implementation of a software within a consulting firm and the associated complexities; by making use of the duality of structure and modalities of structuration to highlight the consequent key organisational changes, the author attempted to understand whether 'new' technologies are better suited than a combination of conventional IS. Walsham (2002) explored the production of cross-cultural software and its use within an insurance company, arguing that IS embody interpretive schemes, provide coordination and control facilities, and encapsulate norms; this implies that IS are deeply involved in the modalities mediating the relationship between agency and structure, being drawn upon to provide meaning, exercise power and legitimise actions.

This research's findings only partially agree with those of the studies mentioned above; for example, Walsham and Han (1993) found that structures of domination are continually reproduced, whilst this study concludes that domination is challenged and significantly changed. The differences are largely down to the nature of the organisations and technologies explored; e.g., crowdsourcing/crowdmapping technologies vs. in-house organisational ones. This study's findings are novel due to the identification of the dependency of both actors in the duality, and its overall fragility. The existing studies that made use of the duality of

structure typically explored how signification, domination and legitimation evolved or changed, but rarely emphasised the positive and negative aspects of a duality. This study was able to identify the dependency and fragility aspects mentioned above because of the temporal period explored—namely, from 2009 to 2015. At the time of writing, the recognised duality is largely bringing positive effects; however, this could change depending on the HOT community's ability to address the critical issues mentioned in the previous pages. Although this study agrees with the duality of technology in the form articulated by Orlikowski (2000), it does so in terms of its standpoint in a critical debate within the IS structural literature—namely, that technology cannot embody structure. As with the duality of technology viewpoint, this study argues against the viewpoint of the AST, which holds that technology can embody structure.

Additionally, because of its use of structuration theory and of its exploration of change over a temporal period considerably longer than those considered by the existing crowdsourcing literature on change—namely, the descriptive-based research that subscribes to the crowd-action perspective—e.g. Brabham (2009), Heinzelman and Waters (2010), Majchrzak and More (2011), Palen et al. (2007), Palen and Liu (2007), Savage (2012), and Sutton et al. (2008)—this study goes beyond this existing literature.

In essence, this study identifies the mutual dependency between crowdmapping and humanitarian response. Through the identification of a duality, it presents impact as something more complex than a simple cause and effect one; this acknowledges the important role played by structuration theory in this study.

7.4 The Diverseness of Intermediaries in the Process of Change

The research findings of this study highlight the importance and diverseness of the intermediaries involved in the process of change; intermediaries in the sense of this study refers to something that acted as a medium or means through which change took place. In the crowdmapping initiative explored by this study, the intermediaries involved in the process of change included the holding of conferences, formation of networks, establishment of institutions (DHOs), crowdmapping exercises, humanitarian responses, negotiations (involving an online petition), testing of new imagery sources, and various other technological

aspects, including quality control and humanitarian technological developments. Table 17 presents these intermediaries involved in the process of change.

Table 17 - Intermediaries involved in crowdmapping for humanitarian response

<u>Intermediaries</u>	<u>Key Aspects of Intermediaries</u>
Milestone Events	ICCM Conference
	Formation of Crisis Mappers Network
	Establishment of DHOs
	Establishment of DHNetwork
Experimental Mapping	Gulu crowdmapping exercise
Use of Maps on the Ground	Haiti, Libyan, Japanese and Haiyan crowdmapping responses
Negotiations	Online petition
Exploration of Imagery Sources	Testing of UAV/drone imagery
Quality Control	HOT tasking manager
	Mapathons
Humanitarian Technological Development	MicroMappers, Verily and AIDR

The detail of these diverse intermediaries, as reported in the analysis chapter (chapter six), is as follows.

The ICCM Conference and Crisis Mappers Network served as a way of connecting multiple actors in offline and online form. Importantly, this meant that both settings acted as ‘bridges’ between two very different communities—namely, the crowdmapping and humanitarian organisation communities. In doing so, they enabled and provided a platform for both communities to familiarise themselves with each other. It was within these settings that Humanitarian Organisation One became aware of how crowdmapping could benefit its humanitarian response efforts.

The establishment of DHOs served as an important intermediary because it heralded the moment at which the hitherto unstructured and unformalised crowdmapping community began to develop better organisation, structure and formalisation of practices. The development of structure was important because it provided a focal point, an organised resource, for those dealing with the crowdmapping community. The establishment of the DHNetwork more explicitly highlights the importance of intermediaries, as it was formed with the sole purpose of formally bridging the gap between the crowdmapping and humanitarian

organisation communities, and streamlining the process by which humanitarian organisations call upon the crowd for their mapping needs. This network has been used by Humanitarian Organisation One, who has activated it on various occasions.

Alongside the Haitian, Libyan, Japanese and Haiyan crowdmapping responses, which provided Humanitarian Organisation One with a wider institutional acceptance of crowdmapping for humanitarian response, the Gulu crowdmapping exercise served as another important intermediary; allowing Humanitarian Organisation One to establish and enhance routines aimed at better using OSM crowdmapped data.

The online petition and testing of UAV/drone imagery were instrumental in changing the imagery procurement process, specifically bringing about the realisation that it needed to be improved; importantly, these two intermediaries contributed to the development of an imagery coordination tool/group, which levelled a considerable challenge to the power over resources held by imagery providers. Last but not least, the technological features of the HOT tasking manager and the development of MicroMappers, Verily, and AIDR also served as important intermediaries, with the former playing an important role in quality control, and the latter serving as a way of further creating and promoting a digital humanitarianism environment. Of course, as organisations do not operate within a vacuum, the development of such an environment also benefitted the HOT community.

Taking into consideration the complex and diverse role played by intermediaries, it would be too simplistic to say that the crowdmapping community—in this case the HOT community—had had an impact on Humanitarian Organisation One’s humanitarian response efforts without fully acknowledging the role played by the aforementioned intermediaries in this impact. All intermediaries had an influence on the process of change, to the point that, had they not, its eventual outcome could have been different. For example, the ICCM Conference played a crucial role in bringing the crowdmapping and humanitarian organisation communities together under one roof for the first time, which was instrumental to both communities understanding what they could offer each other. The online petition and testing of UAV/drone imagery went a long way in challenging the dominance over resources held by imagery providers.

Therefore, this study argues that change can rarely be understood accurately through a conceptualisation that posits that one entity impacts another directly, without at least one intermediary playing some role in the process. This is especially true when tracing impact and change over a period of time as long as the one—2009 to 2015—examined by this study.

In its current state, the crowdsourcing literature does not enable such an understanding of change and of the importance of intermediaries; as such, as previously argued, it advocates a simplistic understanding of change—i.e., that a particular crowdsourcing initiative had a particular direct impact. Of course, it may not be semantically incorrect to do so per se, as this is what may appear on the surface; however, a more in-depth and intricate exploration is likely to also reveal the role played by the intermediaries involved in the process of change.

By identifying such intermediaries, this study goes beyond the simplistic understanding of change currently presented in the crowdsourcing literature. Moreover, the existing literature focuses on the endpoint position of crowdsourcing initiatives, while this study focuses on the process. The review of the papers on outcomes presented in the literature review, chapter two, explicates that the descriptive-based research subscribed to the crowd-action perspective, highlights how crowdsourcing is bringing change to different contexts. For instance, Savage (2012) detailed how a crowdsourcing initiative enabled scientists to solve a problem which had perplexed them for more than a decade; Brabham (2009) argued that crowdsourcing can be used to foster effective public participation in urban planning projects; Palen et al. (2007) detailed the use of crowdsourcing, in the form of citizen-led online forums, during 2005's Hurricane Katrina and the 2003 California wildfires, whilst also highlighting how such forums were used for the avian flu preparation programme in the United States; Palen and Liu (2007) further argued that, due to the increasing role played by ICTs, public participation is an emerging area within humanitarian response, with implications for both its informal and formal aspects; Sutton et al. (2008) interviewed the victims of the 2007 California wildfires on their use of ICTs during the disaster and found that many of them had given up on mainstream sources to instead rely on crowdsourced information; Majchrzak and More (2011) highlighted the case of the 2007 San Diego fires and how crowdsourcing was utilised to support humanitarian response during the disaster; Heinzelman and Waters (2010) explored how crowdsourcing was used during the 2010 Haiti earthquake and detailed how participants had sent SMS, MMS or online reports that would then be mapped. Although the

outcomes literature mentioned above includes only descriptive-based research papers, it is this literature that subscribes to a more liberal understanding of the potential impact of the crowd. The other types of assessing outcomes literature—namely, functionalist-, variance-, process- and interpretive-based research—follow a similar trend: intermediaries are not paid much attention, if at all.

In essence, although the above research highlights how crowdsourcing can deliver change, it provides a rather simplistic understanding of the process; one in which the role of intermediaries is downplayed, or not mentioned at all. Furthermore, the existing literature focuses on the endpoint position of crowdsourcing initiatives, while this study focuses on the process. This study agrees with the above literature in that crowdsourcing can deliver change, but it takes the understanding further by explicating and providing evidence of the involvement of and roles played by intermediaries, which, on occasion, can be just as important. Ignoring this aspect would potentially result in overlooking pivotal events, actors and technologies involved in the process of change.

7.5 The Complex Role Played by Technology

The research findings of this study highlight the complex role played by technology in the process of change. As argued with regard to the diverseness of intermediaries, section 7.4, technology has played an important role, as an intermediary, in bringing about the legitimisation of crowdmapping for humanitarian response within Humanitarian Organisation One. Specifically, the technological component of the intermediary consisted of the HOT tasking manager, which was fundamental for quality control in the crowdmapping process. In addition to this, the development of the MicroMappers, Verily, and AIDR humanitarian technologies, and the widespread coverage given to their usage, further created and promoted a digital humanitarianism environment, thus serving as an intermediary that contributed to the legitimisation of crowdmapping for humanitarian response within Humanitarian Organisation One. Essentially, this legitimisation came about because of what technology enabled Humanitarian Organisation One to achieve for their humanitarian response efforts. For instance, the HOT tasking manager made it possible to implement quality control procedures into the crowdmapping process. Therefore, technology played a prominent intermediary role in legitimising crowdmapping within Humanitarian Organisation One for their humanitarian response efforts, due to the effectiveness afforded in terms of

quality control, and the abilities resulting from the development of humanitarian technologies.

Additionally, the findings show that these controlling and enabling roles can be both played by the same technology, depending on the perspective of the actors who use it, thus detailing the complex role played by technology itself. For example, as stated, the tasking manager, from the viewpoint of both the HOT and Humanitarian Organisation One hierarchies, served to *control* the contributors' crowdmapping output. At the same time and regardless of the controlling role it played, from the perspective of the contributors, it *enabled* the undertaking of detailed crowdmapping. This latter perspective of the tasking manager was further reinforced through the input given by the contributors in its redevelopment; as argued in the analysis, chapter six, some contributors got involved in the redevelopment process by suggesting improvements. Furthermore, the online petition and the technology behind it could be viewed as enabling resources by the contributors, and as performing a controlling function by the HOT and Humanitarian Organisation One hierarchies.

This brings about the realisation that technology and its characteristics should not just be viewed from a single perspective, as this could result in an incomplete understanding of it. Had this study only looked at the tasking manager from the perspectives of the HOT community and Humanitarian Organisation One, it would have gained a somewhat simplistic understanding of technology; however, as it also considered the perspective of the contributors, it was able to appreciate the somewhat dual role played by it.

In its current state, the crowdsourcing literature does not consider the complex role played by technology; it presents the split between the controlling and enabling roles played by technology as clear-cut; conversely, this study emphasises that this is a somewhat simplistic and one-dimensional approach. This is largely because the existing research subscribes to only one particular view of crowdsourcing technology—either the organisational or the crowd-action perspective—rarely acknowledging the other. The organisational perspective literature tends to highlight how crowdsourcing technology can be used to better organise, manage or control the crowd (Allahbakhsh et al., 2013; Hansen et al., 2013; Kittur et al., 2011; Yung et al., 2014). Conversely, the crowd-action perspective literature tends to emphasise the

role crowdsourcing technology can play in bringing about change (Heinzelman and Waters, 2010; Majchrzak and More, 2011; Palen et al., 2007; Palen and Liu, 2007; Sutton et al., 2008).

In essence, this study argues that a simplistic, one-dimensional view of technology does not accurately represent the role it plays in an increasingly complex world; it is somewhat imperative that we now readjust our view to account for this complexity and gain an apt understanding of the controlling and enabling roles that technology can play from the perspectives of the various actors who employ it.

7.6 The Intrinsic Motivations behind Crowdmapping Participation

The research findings of this study highlight the diverse range of motivations of OSM contributors involved in the crowdmapping process; the motivations were found to be previous mapping history, an interest in maps, helping others and making a difference, a hobby, friendly competition, promoting open-source and free-data, and going beyond monetary assistance; taking this into consideration, these largely centred on intrinsic motivations.

Understanding more about the motivations of contributors as to why they engaged in crowdmapping practices serves an important purpose. It allows a more in-depth exploration of the contributor, the building block of any crowdsourcing initiative. Furthermore, by understanding more about the motivations of crowdmapping contributors, DHOs may be able to devise specific strategies to further motivate contributors in future activations, as there is no guarantee that a contributor for one activation will return for a subsequent activation. This can help with the challenge of the retention of contributors; for example, during the Haiyan activation, from the 1,679 contributors, many of these made minimal contributions and then left the crowdmapping process. Motivation is the theoretical concept that is used to explain behaviour and denotes the reasons as to why individuals act, therefore, motivation explains actions or practices; as this study explores the impact of crowdmapping practices, it is important to understand the reasons behind such practices. So in essence, by understanding the motivations of contributors, this study understands in more detail why these contributors decided to crowdmap.

Interestingly, this study found that despite the different intrinsic motivations of the crowd, the crowd was still able to come together as a collective and challenge the HOT and

Humanitarian Organisation One hierarchies, to the point that the control of both was challenged. Despite the motivations of crowdsourcing contributors identified by this study having already being largely explored in the existing crowdsourcing literature on motivation—e.g. altruism, personal enthusiasm/enjoyment, and affinity for crowdsourcing initiative—this study presents motivation in a somewhat different light to the existing literature—e.g. Brabham (2008b), Brabham (2010), Budhathoki and Haythornthwaite (2013), Leimeister et al. (2009), and Arakji and Lang (2007)—which presents a more functionalist-based understanding of motivation. This is because the existing literature firstly, details the different motivations of contributors taking part in crowdsourcing initiatives. Secondly, the literature closely connects contributor motivations with the incentives that can be offered by crowdsourcing systems, as the latter can be tailored through the understanding of the former. Therefore, the existing crowdsourcing literature on motivation attempts to understand crowdsourcing motivations mainly in order to harness the crowd for the benefit of those controlling or managing the crowdsourcing systems. It takes for granted that understanding the motivations of the crowd can be used as a way to tailor incentives that in turn can be used to control or manage the crowd; this study found this not to be the case, as it found the crowd to be knowledgeable and reflexive, and not an entity that can be easily steered to undertake various tasks, as the existing crowdsourcing literature on motivation presents.

7.7 Research Findings in Relation to other explored Theoretical Foundations

This section presents examples of the main findings of this study in relation to the other theoretical foundations explored by this study; this essentially highlights the useful role of structuration theory in elucidating the interesting and novel findings, over the other theoretical foundations initially explored by this study.

For example, looking at the mutual dependency between crowdmapping and humanitarian response finding, section 7.3, from the perspective of the other theoretical foundations explored by this study, highlights the usefulness of structuration theory. The mutual dependency between crowdmapping and humanitarian response finding was able to be explained through the lens of structuration theory. Through exploring structuration theory at the initial stages of study, this study was able to use the theory as a way to explain the duality and subsequent mutual dependency between the identified actors. This allowed a way for the study to present change as something more complex than a simple cause and effect, as

something more complex, as a duality. The other theoretical foundations explored by this study, do not articulate the idea of a duality. Moreover, the theory of practice, as argued in the theoretical foundation chapter even presents altogether a somewhat muffled understanding of change, with social agents essentially being the product of their habitus or, in other words, reactive to it or enslaved by it.

Moreover, looking at the main finding of the role of the crowd, section 7.1, in more detail, from the perspective of the other theoretical foundations explored by this study, again highlights the usefulness of structuration theory.

In terms of the theory of practice, public participation within humanitarian response can be thought of as a field, with competition for imagery resources by actors—therefore, imagery resources can be considered the capital of the field. This having been said, although some of Bourdieu's initial writings argue for the virtuosic intersubjective social practices of social agents, which may be more apt to be to explain change, the central concept of the habitus means that the theory of practice is not suited to explain the type of change viewed by this study. In contrast, structuration theory argues for the knowledgeable and reflexivity of social agents; social agents not constrained by the objective social structures with which they are faced. Therefore, with the introduction of the habitus, Bourdieu no longer attributed the origin of social action to the interaction among social agents. Therefore, according the theory of practice, social agents are not knowledgeable or reflexive in the way argued for by structuration theory, which is what this study found. Bourdieu argued that *"it is because subjects, strictly speaking, do not know what they are doing that what they do has more meaning than they know"* (Bourdieu, 1977, p. 79); this study found the opposite, that in fact, social agents did know what they were doing. Through the online petition they wanted to protest power and control, and through the testing of UAV/drone imagery, they aspired to gain power and control over imagery resources and contest the perceived domination. In essence, the challenging of the domination of resources was able to be aptly explained through structuration theory because of its understanding that social structures as being formed through the agency possessed by social agents, and that every single act can result in transformation or change; an understanding that is stifled through Bourdieu's concept of the habitus.

In regard to ANT, the major drawback in being able to explain the challenging of the domination of resources is the theory's position that all actors are equally involved in networks; therefore, scholars including Bloor (1999) have argued that ANT is incapable of challenging power structures. Moreover, whereas ANT requires some judgement calls from the researcher as to understanding the importance of some actors over others in the network, the crucial insight of structuration theory which anticipates the dialectic of control is that all social systems involve an asymmetrical distribution of resources, meaning that, to some extent, all social systems are characterised by inequality; therefore, in essence, the distribution of resources elucidates domination of some social agents over others, whereas, ANT, considers all actors as having equivalent influence over all other actors in the network. Some scholars have recommended drawing upon structuration theory to overcome certain problems with ANT (Walsham, 1997).

In regard to TAM, the major drawback of the theory is its inability to account for the how and why aspects of change, therefore, not providing a suitable lens to explore the objectives of this study. In regard to the PSIC model, while it may be useful as a sensitising device to explain IS change, as multi-level, punctuated, and socio-technical, it typically requires a theory of explanation to be adopted with it.

In essence, the usefulness of structuration theory over the other explored theoretical foundations is evident through the interesting and novel findings presented by this study.

7.8 Summary of Chapter

In summary, this chapter presents a discussion of the study's main findings. The main discussion points explored are the role of the crowd, the increasing role of crowdmapping in humanitarian response, the mutual dependency between crowdmapping and humanitarian response, the diverseness of intermediaries in the process of change, the complex role played by technology, and the intrinsic motivations behind crowdmapping participation. In highlighting the active role played by the crowd in humanitarian response, this study argues that control over the crowd remained somewhat difficult despite the measures that the HOT and Humanitarian Organisation One hierarchies attempted to implement. Rather than a controllable entity, the crowd should be viewed as being knowledgeable, reflexive, and always possessing a dialectic of control. The increasing role of crowdmapping in humanitarian

response, highlights the digital humanitarian as an actor who crowdmaps during a disaster situation because of the technology at their disposal, and on the most part, undertakes no other humanitarian related work during a disaster situation. The mutual dependency between crowdmapping and humanitarian response is examined in light of the duality between the practices of the OSM contributors and those of Humanitarian Organisation One. The identification of the diverseness of the intermediaries involved in the process of change highlights the important role they play in it. In highlighting the complex role played by technology, this study argues that in acting as an intermediary and depending on user perspective, technology can be seen as playing both controlling and enabling roles at the same time. Finally, the study highlights the dominance of intrinsic motivations behind crowdmapping participation. The motivations of contributors were found to be previous mapping history, an interest in maps, helping others and making a difference, a hobby, friendly competition, promoting open-source and free-data, and going beyond monetary assistance.

Chapter Eight: Conclusion

This chapter presents the conclusions of the research. The first section presents a summary of the study. The second presents the contributions made by the study to the crowdsourcing literature. The third section presents the contributions to the IS literature in general, while the fourth section presents the contributions to the IS structural literature. The fifth section presents the contribution made to practice. The sixth section presents the limitations of the study, while the seventh one presents suggestions for further research. The eighth and final section presents a summary of the chapter.

8.1 Research Summary

Chapter one, the introduction, set the scene for the exploration of the phenomenon of crowdsourcing, and of crowdmapping in particular. Crowdsourcing has proliferated due to the fertile ground created by advancements in digital infrastructures and social computing, which have made it easier to access the intellectual property of the masses. Despite its ever increasing proliferation, crowdsourcing remains largely underexplored by the IS research community; Zhao and Zhu (2014) argued that crowdsourcing *“has seen its wide applications in practice and is yet to receive intense attention from the scholars”* (Zhao and Zhu, 2014, p. 417). The nascent nature of the IS crowdsourcing research means that the existing literature, in its present state, fails to provide an in-depth account of the change that the phenomenon can deliver; this was one of the main motivations for this study to undertake an in-depth exploration of crowdsourcing and of the impact it can deliver. In essence, the ever increasing utilisation of crowdsourcing in everyday society, associated with its minimal exploration in the IS literature, provided the author of this study with the motivation to explore this worthwhile area.

In order to select the particular application of crowdsourcing to explore, an analysis of its most popular instances, such as crowdmapping and crowdfunding, was carried out. Of course, context plays a role in the degree of popularity enjoyed by different instances of crowdsourcing; the author thus looked at its various applications within the humanitarian response context. From this analysis, crowdmapping was perceived to be particularly popular within said context. This study therefore focused upon this instance of crowdsourcing, exploring its nature and dynamics, and investigating and questioning its impact on a prominent humanitarian organisation. At the outset of the data collection, various

humanitarian organisations were considered; as a result, Humanitarian Organisation One, a leading humanitarian organisation, was selected to be the subject of this research. Formally, this study explored the following research question:

- Do the practices of crowdmapping impact humanitarian response? And, if so, how and why?

The author took care in the way the main research question was formulated; the aim was to avoid making the preliminary assumption that crowdmapping did indeed impact humanitarian response. Only once this was established as being the case, was the extent of the impact explored. The study primarily focused on two levels of analysis—namely, the community-level (HOT community) and the organisational-level (Humanitarian Organisation One). Expanding on the research question, this study carried out an in-depth exploration of the crowdmapping phenomenon that, through advancements in digital infrastructures and social computing, has proliferated in the context of humanitarian response. It investigated the contributor practices involved in the development of the crowdmap, a crowdsourced product, and the impact it wielded on a humanitarian organisation's practices. Furthermore, it explored the subsequent impact these practices had on the crowdmapping contributors. Understanding these aspects elucidated the impact and change effected by crowdmapping on the *modus operandi* of a humanitarian organisation's response practices.

In chapter two, the literature review, a critical review was conducted into the crowdsourcing literature. In the case of IS scholars, good practice in conducting a literature review requires searching the 'basket of 8' IS journals for relevant studies. Therefore, this is what the author initially set out to do, but the very few studies found highlighted the 'minimal' nature of the IS crowdsourcing literature, which would have made conducting a critical review considerably challenging. This was despite also including papers that did not explicitly and strictly mention the term 'crowdsourcing' to describe the phenomenon. The author then made the decision to widen the scope of the search; other disciplines, outside of the IS literature, and conference papers were included. The new search criteria proved to be successful, as the author was eventually able to review 47 papers, therefore enabling an in-depth exploration of the crowdsourcing literature. The review highlighted that the current crowdsourcing literature can be classified into three major areas; quality control, motivations and outcomes. It also

became apparent that the three areas represent two different crowdsourcing views: the organisational perspective, from which crowdsourcing is seen more as a controlled phenomenon by presenting ways in which the crowd could be better organised or managed; and the crowd-action perspective, which sees crowdsourcing more as a phenomenon that can bring about change in different contexts. The quality control and motivation literature inclines towards the organisational perspective, whilst the outcomes literature inclines towards the crowd-action one. Furthermore, it became apparent that each perspective is largely linked to the type of research; the organisational perspective being largely represented through functionalist-based research, whilst the crowd-action perspective predominantly represented through descriptive-based research. This having been said, the literature is overall more inclined towards the organisational perspective, downplaying the role played by the crowd and the impact it can have. This imbalance in the literature highlighted an opportunity for research that considers both the organisational and crowd-action perspectives. It also became manifest that process-based research is something of a rarity within the crowdsourcing literature, constraining the understanding of the processes involved in crowdsourcing. In addition, the review of the existing literature highlighted a lack of in-depth interpretive based research, and minimal theoretical engagement. Taking all this into consideration, the review presented an opportunity for the author to contribute with a particular type of study—namely, a process-based interpretive study that theoretically engages with the phenomenon, considering both structure and action elements (the organisational and crowd-action perspectives).

Chapter three reviewed a number of theoretical perspectives that deal with change, and specifically, social and technological change—namely, Structuration Theory, Theory of Practice, Actor Network Theory (ANT), the Technology Acceptance Model (TAM), and the Punctuated Socio-Technical Information Systems Change (PSIC) Model. The chapter focused considerably more on structuration theory, as this was the theoretical foundation adopted, based on the research logic of this study. The main concepts utilised from structuration theory are explained in detail—namely, the concept of the duality of structure, which includes Giddens’s ideas of agency, structure and of the modalities of structuration (Giddens, 1984). Structuration theory was particularly useful as it addresses and explains change. Furthermore, structuration theory presents a balanced view of structure and action (which structuration

theory refers to as ‘agency’). Referring back to the literature review, this understanding of structure and action was particularly useful because of the crowdsourcing literatures’ tendency to downplay the crowd’s role and impact; in other words, action. The chapter also discussed the various ways in which the IS discipline has made use of structuration theory, and argued that there is a need to go back to the theory’s original notions. Moreover, it argued that the IS structurational literature needs to examine additional contexts and types of IS.

Chapter four detailed the research methodology, beginning with the researcher’s interpretive philosophical stance in undertaking the research. It then specified the method adopted—namely, that of a case study with semi-structured interviews—and how this proved insightful in the exploration of the research aims and objectives. Furthermore, detail was provided on the data collection and analysis. The data was collected over a significant temporal period—namely, from 2009 to 2015. The chosen temporal boundary highlights the process-based nature of this study, which enabled the study to better understand the impact of crowdmapping, as compared with, for example, a cross-sectional data approach. Importantly, the collected data details a number of key events that contributed to impact and, ultimately, change. Specifically, the data collection consisted of voice and video interviews, online data, document, newspaper, and media reviews. This diversified collection strategy enabled an in-depth exploration of both technical and non-technical literature. This was particularly beneficial because a number of the key events in the case study, such as crowdmapping during the Haiti and Haiyan, had received a considerable amount of coverage; therefore, the non-technical literature was just as important as the technical one. Furthermore, the decision to select the OSM crowdmapping tool was made after exploring the non-technical literature, as, from the initial case study built up through the mainstream media, it was clear that OSM was the most prominent crowdmapping tool in use at the time. In total, 43 voice and video interviews were conducted, while email communication was held with nine other participants. Online data were collected, from a mailing list/forum and through instant messaging, and the documents and online resources reviewed included agency reports, news items, television interviews, and video recordings. The 43 voice interviews were conducted with various actors, including the HOT community, and various humanitarian organisations, including the American Red Cross, UN OCHA, MapAction, and specialists from NEDA. Further

interviews were conducted with relevant actors from DigitalGlobe and Mapbox to ensure a comprehensive understanding and exploration of crowdmapping in the context of humanitarian response.

Chapter five presented the case study on the development of crowdmapping in the context of humanitarian response. It traced the development of crowdmapping from 2009 to 2015 and described the various developments and changes that have taken place in this period of time. It was deemed useful to begin by looking at the 2010 Haitian earthquake as the first major response, as this was the disaster that saw the rise to prominence of crowdsourcing and, in particular, crowdmapping. The major crowdmapping developments explored, in chronological order, include the Haiti response, the rise of digital humanitarian organisations, the 2011 Libya and Japan responses, technological advances related to crowdmapping, the Haiyan response, and the development of partnerships and agreements between actors since Haiti. By developing a case study, this research was able to build a mental concept of the crowdmapping phenomenon (Pan and Tan, 2011); this was helped by the initial perusal of ‘non-technical literature’ such as newspapers, letters, and biographies.

Chapter six presented the study’s analysis, which details that crowdmapping is indeed having an impact on the aforementioned humanitarian organisation’s response efforts. It highlighted the various community-level practices that contributed towards the development of the crowdmap. Furthermore, it detailed change in terms of meaning, domination and legitimisation. The evidence for the evolution of meaning and for the emergence of legitimisation within Humanitarian Organisation One in regard to crowdmapping for humanitarian response was detailed. Furthermore, the evidence for the challenge brought by the HOT community to domination in the imagery procurement process was also presented. In addition, the analysis detailed the community-level changes brought about by the consequent organisational-level practices—namely, changes in crowdmapping practices. Interestingly, this showed the duality that exists in the relationship between the remote efforts of crowdmapping and the organisational efforts of humanitarian response. Over time, this discursive dual relationship has contributed to the shaping of both the crowdmapping efforts and the humanitarian organisations’ internal capabilities. Therefore, the analysis revealed that crowdmapping does not have a straightforward cause and effect impact. Also, the chapter detailed the critical issues faced by the HOT community in regard to four main

areas; it is important to stipulate these because of the mutual relationship. Additionally, the chapter detailed a profile of the crowdmapping community.

Chapter seven presented the discussion. The points explored in relation to the research findings were the role of the crowd, the increasing role of crowdmapping in humanitarian response, the mutual dependency between crowdmapping and humanitarian response, the diverseness of intermediaries in the process of change, the complex role played by technology, and the intrinsic motivations behind crowdmapping participation. In highlighting the active role played by the crowd in humanitarian response, this study argued that control over the crowd remained somewhat difficult despite the measures that the HOT and Humanitarian Organisation One hierarchies attempted to implement. Rather than a controllable entity, the crowd should be viewed as being knowledgeable, reflexive, and always possessing a dialectic of control, where all forms of dependency offer resources to influence. The increasing role of crowdmapping in humanitarian response, highlighted the digital humanitarian as an actor who crowdmaps during a disaster situation because of the technology at their disposal, and on the most part, undertakes no other humanitarian related work during a disaster situation. The mutual dependency between crowdmapping and humanitarian response is examined in light of the identified duality between the practices of the OSM contributors and those of Humanitarian Organisation One. Specifically, the duality is indicated by Humanitarian Organisation One investing into OSM both creatively and financially, through the redevelopment of the tasking manager, which has created new crowdmapping conditions for OSM contributors. This mutual shaping of practices highlights how both the HOT community and Humanitarian Organisation One are benefitting from the duality. This having been said, due to the mutual dependency, the critical issues faced by each actor would not be exclusive to it; rather, it would also affect the other. It is particularly important to highlight this because of the identified issues faced by the HOT community; these, moreover, raise questions concerning the whole crowdmapping process and its perceived fragility. The diverseness of intermediaries in the process of change highlights the important role played by intermediaries in the process of change. For the crowdmapping initiative explored by this study, the intermediaries included the holding of conferences, the formation of networks, the establishment of institutions, crowdmapping exercises, humanitarian responses, negotiations (involving an online petition), the testing of new

imagery sources, and various other technological aspects, including quality control and humanitarian technological developments. This study also highlighted the complex role played by technology; in acting as an intermediary and depending on user perspective, it can be seen as playing both controlling and enabling roles at the same time. Finally, this study highlighted the dominance of intrinsic motivations behind crowdmapping participation. The motivations of contributors were found to be previous mapping history, an interest in maps, helping others and making a difference, a hobby, friendly competition, promoting open-source and free-data, and going beyond monetary assistance.

This chapter, chapter eight, presents the conclusions. It begins with the research summary, which recaps all the chapters of the thesis. It then moves onto the research contribution made by this study to the IS crowdsourcing literature and wider discipline, to IS structural literature, and to practice. In terms of its contributions to structuration theory, the novel way in which the theory is applied is articulated—namely, in terms of the types of organisations and technologies explored. In terms of the contributions made to practice, an exploration of the ways in which the HOT community could tackle the identified critical issues it faces is provided. The chapter concludes with the limitations of the study, and suggestions for further research.

8.2 Contribution to IS Crowdsourcing Literature

This study primarily makes a contribution to the IS crowdsourcing literature. As detailed in chapter two and in the research summary paragraph above, it does so through an exploration of both the organisational and crowd-action perspectives of the crowdsourcing phenomenon, providing a detailed and in-depth account of the change that it can deliver. In essence, this study theorises aspects of how and why a particular instance of the crowdsourcing phenomenon—namely, crowdmapping—delivers change in the context of humanitarian response. These aspects include the role of the crowd, the increasing role of crowdmapping in humanitarian response, the mutual dependency between crowdmapping and humanitarian response, the diverseness of intermediaries in the process of change, the complex role played by technology, and the intrinsic motivations behind crowdmapping participation; therefore, this study details six key discussion points.

Through its identification of the role of the crowd, this study adds to the understanding of control afforded by the existing crowdsourcing literature that presents a limited understanding of the agency of the crowd, presenting the crowd as an entity that can be easily steered to undertake various tasks. For example, Kittur et al. (2011) proposed quality control methods that utilise human intelligence; namely, the map-reduce approach. This is enacted by means of some contributors verifying the contributions made by others (represented through map tasks) and by a voting method whereby a single contribution from many is voted as being the best (represented through reduce tasks). Other methods include combining the best parts of various contributions pertaining to the same task, instead of selecting a single one (represented through reduce tasks). Yung et al. (2014) built upon the work of Kittur et al. (2011) by proposing a crowdsourcing system architecture that enables a new quality control approach enacted by means of evolutionary computing and slow intelligence. Hansen et al. (2013) explored the effectiveness (accuracy) and efficiency (time) of two quality control mechanisms put in place within the crowdsourcing system—namely, arbitration and peer review. Allahbakhsh et al. (2013) classified quality control methods in the two categories of design-time and real-time; design-time methods apply to effective task preparation and contributor selection, while real-time ones deal with expert review, ground truth, input agreement, output agreement, majority consensus, contributor evaluation, and real-time support. In contrast to the existing literature on crowdsourcing, this study provides a more thorough understanding of crowdsourcing and quality control, identifying the knowledgeableability, reflexivity and dialectic of control possessed by the crowd in effectively tackling methods aimed at controlling it.

This study also identifies the increasing role of crowdmapping in humanitarian response, despite it being previously dominated by humanitarian organisations and government agencies. The knowledgeableability and reflexivity of OSM contributors has evolved them into a community capable of playing a role in humanitarian response. The crowdmapping practices of contributors is resulting in a new type of humanitarian, the digital humanitarian. The digital humanitarian is an actor who crowdmaps during a disaster situation because of the technology at their disposal, and on the most part, undertakes no other humanitarian related work during a disaster situation. In essence, this understanding of the agency of the crowd and the important role that it can play in humanitarian response through the development of

crowdmaps, takes the existing crowdsourcing literature further—e.g. Brabham (2009), Heinzelman and Waters (2010), Majchrzak and More (2011), Palen et al. (2007), Palen and Liu (2007), Savage (2012), and Sutton et al. (2008)—by exploring the more longstanding effects of crowdsourcing.

This study identifies the mutual dependency between crowdmapping and humanitarian response, in light of the duality between the practices of the OSM contributors and those of Humanitarian Organisation One. Change is identified as something that is neither simple nor straightforward, but a complex and gradual process that is achieved through the involvement of many different intermediaries. The existing literature on crowdsourcing and change details it as something that is one-way, appearing suddenly, and producing surprising results. For example, Savage (2012) detailed how a crowdsourcing initiative enabled scientists to solve a problem which had perplexed them for more than a decade; Brabham (2009) argued that crowdsourcing can be used to foster effective public participation in urban planning projects; Palen et al. (2007) detailed the use of crowdsourcing, in the form of citizen-led online forums, during 2005's Hurricane Katrina and the 2003 California wildfires, whilst also highlighting how such forums were used for the avian flu preparation programme in the United States; Palen and Liu (2007) further argued that, due to the increasing role played by ICTs, public participation is an emerging area within humanitarian response, with implications for both its informal and formal aspects; Sutton et al. (2008) interviewed the victims of the 2007 California wildfires on their use of ICTs during the disaster and found that many of them had given up on mainstream sources to instead rely on crowdsourced information; Majchrzak and More (2011) highlighted the case of the 2007 San Diego fires and how crowdsourcing was utilised to support humanitarian response during the disaster; Heinzelman and Waters (2010) explored how crowdsourcing was used during the 2010 Haiti earthquake and detailed how participants had sent SMS, MMS or online reports that would then be mapped. In contrast to the existing literature, this study goes beyond this simplistic understanding of change to unravel its process and gradual occurrence. It also provides a balanced view on change, showing its positive and negative aspects and the reciprocal dependency it brings. Moreover, through the identification of dependency by both actors in the duality, and the overall fragility of the relationship, the findings of this study go beyond those produced by other IS structural research. The existing studies that made use of the of duality of structure,

such as Karsten (1995), Walsham (2002), and Walsham and Han (1993), typically explored how meaning, domination and legitimation have evolved or changed, but rarely emphasised the positive and negative aspects of a duality.

By identifying the diverseness of the intermediaries involved in the process of change in crowdsourcing, this study adds to the existing understanding of it. The identified intermediaries—which include the holding of conferences, formation of networks, establishment of institutions (DHOs), crowdmapping exercises, humanitarian responses, negotiations (involving an online petition), testing of new imagery sources, and various other technological aspects including quality control and humanitarian technological developments—place this study beyond the descriptive-based research subscribing to the crowd-action perspective; e.g., Brabham (2009), Heinzelman and Waters (2010), Majchrzak and More (2011), Palen et al. (2007), Palen and Liu (2007), Savage (2012), and Sutton et al. (2008).

By its identification of the complex role played by technology, this study adds to the understanding afforded by the literature on technology's role of either controller or enabler. This study identifies that technology can play either of these roles, but importantly, also both, depending on the perspective of the user. Furthermore, technology is identified as being an important intermediary involved in the process of change. The understanding presented in this study more accurately represents the complex role played by technology.

This study also highlights the dominance of intrinsic motivations behind crowdmapping participation. The motivations of contributors were found to be previous mapping history, an interest in maps, helping others and making a difference, a hobby, friendly competition, promoting open-source and free-data, and going beyond monetary assistance. Despite these motivations already being largely explored in the existing crowdsourcing literature on motivation—e.g. Brabham (2008b), Brabham (2010), Budhathoki and Haythornthwaite (2013), Leimeister et al. (2009), and Arakji and Lang (2007)—this study presents motivation in a somewhat different light by going beyond a functionalist-based understanding of motivation. Where the existing literature takes for granted that understanding the motivations of the crowd can be used as a way to tailor incentives that in turn can be used to control or manage the crowd; this study found this not to be the case, as it found the crowd

to be knowledgeable and reflexive, and not an entity that can be easily steered to undertake various tasks.

Moving forward, the crowdsourcing literature would increasingly benefit from more theoretical understandings that elaborate on the impact and change that the phenomenon can deliver. Although this study argues favourably for such change, its findings are specific to the context examined. Understanding the change that crowdsourcing can deliver from a number of different perspectives would enhance our understanding of the phenomenon. By exploring the phenomenon of crowdsourcing theoretically, this study takes a step forward in moving the crowdsourcing literature towards theoretical maturity.

Moreover, this research is a process-based study, which deepens the understanding of the process of crowdsourcing delivered by the existing crowdsourcing literature, by being able to view many changes at both the community-level (HOT community) and the organisational-level (Humanitarian Organisation One). The lack of process-based approach is perhaps a reason why previous studies within the crowdsourcing literature have either dealt with one level or the other, in regard to the organisational or crowd-action perspectives; the short temporal period explored is likely to have revealed the ascendancy of one perspective over the other. In addition, this research presents an interpretive-based study, which, again, is lacking in the existing literature.

8.3 Contribution to IS Literature in General

This study also makes a contribution to the broader IS literature. It makes a contribution to the wider IS debate of structure vs. action. By utilising structuration theory, it attempts to avoid taking an asymmetrical view of structure and agency and argues that they are mutually constitutive. Both are equally important because they mutually depend upon each other. Social agents draw upon structures when they act, while, at the same time, the social agents' actions serve as a basis upon which structures are produced or reproduced.

Additionally, Chiasson and Davidson (2005, p. 597) argued that, because industry exerts an important influence on the meaning of IS phenomena, and IS research has consistently "*concentrated on a small subset of industries*", attention should be given to a wider array of different industrial sectors. Wastell (2006, p. 213) argued that, in comparison to public sector research, "*there is a general tendency in our field to privilege the private sector*"; the same

can be said when comparing private sector research with that focused upon the voluntary sector. Other authors—for example, Yoo (2010)—have also argued for the discipline to decisively expand the scope of its inquiry. This study submits to these views and responds to many other similar calls made recently; it does so by examining the role played by IS, outside of traditional commercial organisations, in a humanitarian one (this also contributes to IS structural research; in section 8.2.2, the contributions to IS structural literature are detailed).

In a recent paper, Walsham (2012) argued that the IS literature needs to expand its agenda to understand whether ICTs are making the world a better place. He vehemently argued that *“it is not enough to pursue the traditional agenda in the future if the IS field is to remain an exciting one with a vision which can inspire and unite us, particularly younger people coming in to the area. We need a broader ethical agenda of making a better world and we must embrace new technologies and new settings where ICTs are important”* (Walsham, 2012, p. 90). Also, in a recent MISQ call for papers regarding ICTs and societal challenges, it was argued that the IS discipline needs to broaden its horizons and focus on societal issues. Specifically, the call was for IS research to explore *“how ICT-enabled platforms help NGOs complete social missions”* (Majchrzak et al., 2012, p. 2). This paper attempts to answer these calls through the exploration of the impact of crowdsourcing in the context of a natural disaster, where crowdmapping has ‘made a difference’ in enabling a humanitarian organisation to more efficiently respond in assessing damaged areas and allocating resources to relief efforts, which had an impact on the ground. Through the exploration of a humanitarian organisation, it answers the call to better understand the societal impacts of ICTs.

8.4 Contributions to IS Structural Literature

By deriving the empirical insights detailed in the analysis (chapter six), structuration theory provided a valuable lens through which to conceptualise and make sense of the impact of crowdmapping on humanitarian organisations.

As detailed in the theoretical foundation (chapter three), the IS literature has made use of structuration theory in three main ways; a first set of literature applied structural concepts such as the duality of structure, the dialectic of control, unintended consequences, etc. Two more sets of literature based themselves on adaptations of the theory—namely,

AST, developed by DeSanctis and Poole (1994), and the duality of technology, developed by Orlikowski (2000).

Following the views of Jones and Karsten (2008), this study adopts a formulation of structuration theory closer to the original; hence the use of the aforementioned theoretical concepts. In essence, our understanding of the phenomenon of crowdsourcing and of the change it can deliver is enhanced by the use of structuration theory; in this way, this study adds to the IS crowdsourcing literature, which lacks theoretical grounding. Moreover, the chosen context, crowdmapping and its impact on humanitarian organisations, is also enhanced by this study's theoretical grounding.

Furthermore, through the context and phenomenon chosen, this study also enriches the IS structural literature. In doing so, it answers the call, made by Jones and Karsten (2008), for the IS literature grounded in structuration theory to become more adventurous in terms of context and chosen technologies. Typically, the IS structural literature focuses on traditional organisational settings and technologies, such as computer-mediated communication and groupware. Conversely, this study looks at a non-traditional organisational setting—namely, a crowdmapping community and a humanitarian organisation. It also focuses on non-traditional technology—namely, crowdmapping. The selection of the context and phenomenon to be studied was justified by the analysis, which detailed the considerable impact made by crowdmapping on humanitarian organisations, and that made by humanitarian organisations on crowdmapping. By using structuration theory and focussing on non-traditional organisational settings and technologies, this study encourages more studies to do likewise; this could potentially result in structuration theory revealing more interesting insights.

In essence, by grounding itself on structuration theory, this study makes an in-depth theoretical-based contribution to the existing IS crowdsourcing literature. Additionally, it also adds to the IS structural literature because of the context and technologies explored.

8.5 Contributions to Practice

This study identifies considerable practice issues, particularly for the HOT community; tackling these issues is increasingly pertinent because of the identified duality and mutual shaping of practices that exist between the HOT community and Humanitarian Organisation One. During

the Haiyan activation, the issues identified centred on four main areas: 1) the lack of specification by the organisation of the accuracy required in quality control editing; 2) the lack of familiarity of non-local contributors with regard to locally specific satellite imagery; 3) the lack of contributor awareness pertaining to the use of crowdmaps on the ground by humanitarian organisations; 4) the lack of feedback given to contributors on their general crowdmapping practices.

The four critical issues listed above can be tackled in two main ways—namely, training and feedback. The first two issues can be met through adequate training. For example, in relation to the lack of specification regarding validation, a short step-by-step guide to validation tasks can be developed and sent to all the contributors participating in the activation, including the less experienced ones, who may be thus motivated to gain the experience needed to participate in validation tasks. To diversify the training portfolio, a short video can also be developed detailing the validation steps. Similarly, in relation to the mapping of local contexts by non-local contributors, a short document depicting the infrastructure typically found in the local context can be developed. As the preparation of such a document, for feasibility reasons, may not be possible prior to the activation, it would need to be carried out on an ad-hoc basis and then sent out to all contributors.

Dealing with the other two issues—namely, the lack of feedback on the use of crowdmaps on the ground, and on mapping practices—centres on developing effective feedback mechanisms. The feedback on the use of crowdmaps on the ground can again be provided through a document sent to participating contributors. Ideally, this should include testimonies from humanitarian organisation personnel who operated on the ground. As articulated by the HOT Board Member, there is minimal communication towards the HOT community from the humanitarian organisations that make use of developed crowdmaps. To counteract this, effective communication channels should be developed to ensure that ground level information is passed up to those leading the activation and, subsequently, to the rest of the community. This would further motivate contributors by supplying them with evidence of the tangible impact of their efforts. As, in practice, it may not be possible to provide detailed qualitative mapping practice feedback to each contributor after an activation, perhaps efforts could be directed towards generating more general quantitative-based feedback detailing, for example, the number of contributions made, the areas mapped,

etc. Ideally, the HOT community should aim at providing every participating contributor with two documents; the first should include details and testimonies on how crowdmaps were used on the ground, and the second should provide some statistics pertaining to the contributor's mapping efforts. This would go a long way in dealing with the retention issues faced by the community.

Furthermore, and as part of the same effort, the HOT community should be looking at more ways in which to diversify training methods. In addition to existing methods, such as the mapathon, it is evident that more effort is needed in diversifying the training portfolio, so that contributors do not feel, so to speak, lost. During the Haiyan and Nepal activations, many contributors made very few edits or even stopped mapping because, amongst other reasons, they found the learning curve to be too steep and the training methods to be inadequate. This having been said, of late, an effort has been made to improve training methods through the renewed development of learnosm.org.

This study agrees with the views put forth by Wastell et al. (2003), who stated that the extent to which organisational change takes place depends on three aspects; the perception of threats directed at the organisation, the degree to which these threats are acknowledged, and the level of self-efficacy in implementing the changes required to deal with the perceived threats. Thus, for the HOT community to effectively deal with the issues described above, it is important that these are aptly recognised within the hierarchy. If such recognition is not widespread, then those who do recognise them need to educate and convince others of their long-term impact, lest they are not tackled. Once recognition of the criticality of the issues becomes prevalent within the community, the will to bring about change will be much stronger and the drive for change will be supported. Once the hierarchy is committed to deal with critical issues, the community's self-efficacy will play a major role in how it approaches them. If the community harbours the strong belief that the issues can be met effectively, the forecast for change is positive; otherwise, it may be met with resistance.

8.6 Research Limitations

In the case of this study, the identified impact of crowdsourcing on the chosen organisation could have been due to the particular instance and context of the crowdsourcing explored—namely, crowdmapping in the context of humanitarian response. This study recognises that

other instances of crowdsourcing may or may not bring about the changes identified by this study.

Furthermore, as it mainly explored the impact of crowdmapping on Humanitarian Organisation One, this study recognises that crowdmapping may not have had the same effect on all the humanitarian organisations that have made use of it in the context of humanitarian response.

This having been said, this study subscribes to the IS interpretivist paradigm and follows Walsham's (1995) guidance on generalisability: it applies generalisability to concepts and conceptual development rather than to context itself.

8.7 Further Research

As detailed, this study has explored in-depth the impact of crowdmapping on a humanitarian organisation's response efforts, and finds that there is an impact to the extent to which there is mutual dependency between both.

Moving forward, this study is just a part of the wider exploration of the crowdsourcing phenomenon, and there are many more ideas that could benefit the related literature.

To further understand its impact, future studies could be expected to explore other instances of crowdsourcing in different contexts, and even crowdmapping in different contexts to humanitarian response. This would help elucidate the wider impact of crowdsourcing and the changes that it is bringing.

Additionally, further studies could explore whether crowdmapping has an impact on other humanitarian organisation's response efforts, and even whether a mutual dependency exists for these organisations.

Also, as the identified critical issues faced by the HOT community are central to the argument made by this study (i.e., that the crowdmapping process is based on a fragile relationship), future studies could be expected to explore whether these have been tackled by it.

This study adopted structuration theory and benefited from its symmetrical perspective of structure and agency; thus, to gain interesting insights into the crowdmapping phenomenon,

it would be useful to compare its findings with those of studies based upon different theoretical foundations.

Moreover, an in-depth exploration of the dynamics of interaction and of the issues surrounding the retainment of contributors within crowdmapping communities (such as the HOT community) could provide interesting insights.

Other potential areas of interest for scholars could include further deciphering the motivations of those contributing to crowdmapping initiatives, such as OSM. This would add to the existing crowdsourcing literature on motivation in different contexts and instances of the phenomenon.

Of further interest could also be the virtual aspects of crowdsourcing, the impact of such virtuality on coordination, cooperation, outcomes, and how virtual aspects could be incorporated into crowdsourcing initiatives. Understanding the virtuality of crowdsourcing beyond the geographical distribution of contributors may help shed more light on the dynamics of the crowdsourcing communities (Panteli and Chiasson, 2008).

Moreover, to gain a more critical understanding of the impact of crowdsourcing, it would be important to explore those organisations—both humanitarian and non-humanitarian—that, post-evaluation, have decided not to make use of crowdsourcing.

8.8 Summary of Chapter

In summary, this chapter has presented the conclusions of the study. It began with a summary of the research, which recapped all the chapters of the thesis, and then moved on to the research contributions made by this study to the IS crowdsourcing literature and to the wider discipline, to IS structural literature, and to practice. With regard to this study's contributions to structuration theory, the novel way in which the theory is applied was articulated—namely, in terms of the types of organisations and technologies explored. In terms of this study's contributions to practice, ways in which the HOT community could tackle the identified critical issues it faces were explored. The chapter concluded with the limitations of this study, and suggestions for further research.

Appendix 1 – Differences between Types of Research

Descriptive-based: Authors only describe events that have taken place. Cases of crowdsourcing normally conclude that it is an important phenomenon and is bringing change to a number of areas. Authors do not specify any particular theoretical orientation. In essence, this type of research is limited to the description of the phenomenon/object of study or its impact, without in-depth analysis.

Functionalist-based (Normative, Managerial): This research goes beyond description, as its purpose is to also point out ways in which the phenomenon/object of study can be improved. Typically, authors propose a model with regard to how to make use of the crowd, and then present a simple case study to confirm the model. There is no statistical testing nor are there suggestions of internal dynamics between factors. This is adopted from Burrell and Morgan (1979).

Variance-based: This research aims at providing explanations in regard to the relationships between independent and dependent variables.

Process-based: This research aims at providing explanations in regard to patterns in activities, events, and choices over time; temporality is of fundamental importance to process-based research (Langley, 1999, 2009; Langley et al., 2013). The distinction between variance- and process-based research was introduced to the IS field by Markus and Robey (1988).

Interpretive-based: This research aims at providing a subjective account of the phenomenon/object under study. It involves the collection of data, typically through qualitative methods. It differs from process-based research in the sense that there is no explicit consideration of temporality. Authors may or may not specify a theoretical orientation whilst conducting interpretive research.

Appendix 2 – Examples of Subjects Explored in the HOT Mailing List/Forum in November 2013 during Haiyan

<u>Subjects Explored</u>	<u>Month Initiated</u>
3 weeks after #YolandaPH. New mapping needs: islands, debris, ...	November 2013
ICCM - NBO Mapping Party	"
First satellite post-typhoon Tacloban city maps available	"
DigitalGlobe imagery - Haiyan	"
Please sign a petition for more open access to satellite imagery for the Philippines	"
Post-disaster imagery of Tacloban area available	"
Typhoon Haiyan Mapping Progress	"
Activation for Typhoon Haiyan (Yolanda)	"
Assist with satellite imagery tracing	"
Conflating island names from topographic maps	"
First satellite post-typhoon Tacloban city maps available	"
New Task manager job - Typhoon Haiyan - Masbate Island Roads	"
PHL: making use of building damage data	"
Philippines mapping press coverage	"
Preparations for Typhoon Haiyan	"
Tagging scheme for damaged buildings	"
Typhoon Haiyan Tracing -- Please Assist	"

Appendix 3 – Sample of Skype Instant Messaging Conversation

[anonymous] is quite an advocate for drone imagery. He was saying he delivered a presentation in [anonymous].

Sat imagery is one nice big image taken from way up, planes are more images but still pretty high so everything is almost "straight down". With drones, because you are so close the edges of each image are looking a lot more sideways than straight down. This can be useful, and sometimes this is actually the kind of imagery you want, but it makes processing it into a tile layer, as well as subsequent tracing from that tile layer much more difficult. Don't get me wrong, they definitely have their place and I think we will use them a lot, but we will use them in conjunction with sat/aerial imagery, not instead of.

Ok. Plus, with the 45-degree angle, you can have a more accurate picture of buildings, damage etc.

Yes, for that it would be really nice. You can also get POI data like names of shops, where schools/hospitals are, religious buildings, etc. So I envision it being something like, first trace all the buildings and roads from the sat imagery, then go back and do a 'damage assessment'-like second pass and add in all that other information to each building.

That sounds like a very good scenario.

The other big advantage of drones is that since they fly low, they are below clouds, so we don't have to wait for the skies to clear after a hurricane or flood to acquire post disaster imagery. The drones can go out as soon as the wind dies down.

Appendix 4 – Example of Interview Transcript

OSM contributor example interview transcript

Hello [anonymous], how are you?

Hey, how are you?

I'm good, and you?

Great.

Nice to hear from you. Just before I proceed, is it okay if I record the call? I will transcribe the call and use the important parts for my research.

Sure, it's okay for me.

Okay great. So where exactly are you based in Germany?

New Berlin.

Nice, so what's the weather like today?

Sunny. Sunny and warm.

That's good. I'm in London and its very nice here too. Normally at this time of year it starts to get cold, but so far so good.

London, isn't it the foggy place in the world?

To be honest, the summers are always very nice here. So [anonymous], to give you a brief background of my research. I am a PhD student at Royal Holloway, University of London. My research is exploring the phenomena of crowdsourcing. In the literature, crowdsourcing is an underexplored area as it's only recently been further proliferated. I have always been interested in natural disasters and as unfortunate as Typhoon Haiyan was, it has turned out to be a very good example of crowdsourcing and specifically crowdmapping. From my analysis of the mainstream media it became apparent that OSM was most used mapping tool, so that's why I'm focussing on it. What I'm trying to do at this stage is to build up a comprehensive picture up of the mapping processes that took place during Haiyan. I'm looking to ask you

around the areas of the mapping processes, the technology, the satellite imagery and the impact of crowdmapping. Is that okay so far?

Yes, it's okay. Sorry for my not very good English.

No no, your English is very good. That's the nature of crowdsourcing, people are based all around the world and not everyone speaks the same language. So to begin with can I would like to gain an understanding how the crowdmap was built up? What did you do at the different stages to help build the maps up?

Generally, or for the Typhoon?

Yes, specifically for Typhoon Haiyan please.

I have to think about it, it's been a while.

No problem, take your time, it's perfectly fine.

I have a look at my profile on OSM, so I can remember.

Sure, no problem.

I remember I mapped huge areas of buildings, it was very strange work because it's hard for me to decide is that white piece of pixel a building or not, because in our region buildings have much more dimensions. Yeah, I have to search Tacloban.

So is that where you did most of your mapping?

Yes, Tacloban was my main region for building mapping. Yeah, yeah, yeah. Building mapping. Okay what do you want to know exactly?

Just basically your daily activities when you were mapping in regard to it. What type of mapping did you do etc.?

Okay when I saw the tasks, I took my working time, don't tell my boss (laughs). So I decided to map building because the main streets already were done, so in my opinion the buildings from the very young imagery, satellite imagery was very important for me. So there were some regions with very very small huts and shelters and buildings, so I had a lot of problems to decide is that a building or is that a cow, because the little

pieces of colour, you saw only some pixels that were coloured and you didn't know where or what it was. So it was very hard to decide what was a building or not.

Is that because the buildings in Philippines are different to Europe for example?

Yes, because they were very small. There were many slums, so I couldn't decide every time, is that a hut, a building of a hut, one square metre or was that I don't know something else. So then the imagery was not very good because they were created very fast after the disaster, so the resolution was not very good and you saw clouds over the map and so on, it was very hard to decide where and what to map and whatnot.

So how did you counteract this problem?

It was just a training thing. I took very much time for lets says scanning the area, so to get the right view for some special things I looked at the work of other mappers, what they decided to map and so you train your own self.

So you learned yourself and got used to it?

Yeah, that's right.

You said that by the time you started to map, most of the roads had been done and you were mapping buildings.

Yes, that's right.

So it took you time to get used to the terrain. What is it that motivates you?

I don't know, I liked the OSM project from the beginning. It's interesting to contribute your own knowledge for free use for everything and I have to say in my past I worked in rescue teams as well, so I knew the problems the rescuers in Philippines faced, I knew the problems of them. So it was not a great decision for me to make my contribution in the areas. In my area here in Berlin you work only, you map benches, it's not interesting for anybody, but there in the Philippines it is a life rescue thing, so why take time for mapping benches and parks when I can help the rescuers in the disaster area.

That's an interesting point. So you felt that your contribution would have much more of an impact than perhaps if you were mapping in Germany?

Yes, that's what I wanted to say.

You said it very nicely actually. So what do you think was expected of you as a contributor?

I think the main thing that is expected from any mapper in the world is to work very accurate, in a very accurate way, so you have to work very precisely and fast. So the thing is you don't know really where let's say is that a path or is there nothing, or just a shadow of something or not. You have to interpret, in my opinion you have to, you can't map loosely because it's not the exact way to map an area. The rescuers can't decide is there a way to get to the people and so it's a main thing to work in an accurate way.

So accuracy was one the main things expected of you a contributor?

Yes, I think so.

Okay, by the end of the mapping process, after you had made all contributions, how would you rate how your mapping processes went? Did you reflect on this at all?

I think I can't say this because I don't the reality. So I don't know if that thing I mapped is as a building or a path, is really a path or a building, or is still existing, so I can say for me that I did my best to decide the right thing but I can't say that if it was really a good job I did or not.

Do you think that you should have received some feedback on this?

I didn't get any feedback. I think I would have liked this of course.

From looking at the contributor list, I can see that you made over 18,000 contributions.

If you say that (laughs). I don't know. I had a lot but I don't know the real number.

Did you do anything other than mapping during Haiyan?

It was just the mapping for me.

Understanding more about your mapping habits, was Haiyan the first disaster that you mapped?

I have to think to think about it. It was the biggest one. I don't know if there was a little contribution in a HOT contribution before. After Haiyan, I have contributed to other disasters.

Okay, do you think Haiyan changed your thinking in anyway in how effective crowdmapping can be?

No, not really, I always thought that way, that OSM can help people in different ways, so it was not for me an example on how good HOT can be. I think I always thought that OSM can help people in different ways so I can't say that it changed my thinking in that way.

Okay, you mentioned that you had some rescue experience, what exactly was that?

I worked as a lifeguard in water areas. So in Germany it is a problem that the water rescue units don't get any money from the state, so it's always a problem to work as a rescuer in that way, so we need the help of as many people as possible, so I understand the necessity of OSM for the rescuers in the Philippines.

Do you think that because you worked as a volunteer lifeguard contributed towards you becoming a volunteer in other aspects?

Yes, I think so.

Interesting, can you remember where you originally heard about OSM and HOT?

I think that it was around 2005, I first heard of OSM. The HOT project much later, let's say something around 2010/2011.

Okay. Understanding more about the OSM community during Haiyan, can you tell me about the structure of the community?

Let me think about it. I can't say anything about it. I don't know, I can't remember any problems because I worked in OSM a lot and the few things with the Hot software or the imagery or something like that I could solve by myself, because I'm a computer

scientist and such things are not a problem for me. I don't know anything about the structure.

Do you communicate with any other mappers?

Yes, a friend of mine already mapped in Tacloban so we communicated with each other about it. Also, we motivated each other. We motivated each other in the way we had a look at the number of contributions and so it was a little bit funny, although the bad background of the work. It was sort of like a championship challenge between both of us, how many buildings he placed and I placed by myself. So it was like a competition between us to see who could map the most.

Okay, great. [anonymous], when you were mapping for Haiyan, were you in touch with anyone in the Philippines in anyway whatsoever?

No, I was not.

Moving onto the technological aspects of OSM, can you describe what you know of the technologies involved? Such as the different editors.

I worked with JOSM and a browser just like Firefox or something like that. There were no magic tools that I used, yeah I worked with JOSM, and it's for me the best OSM editor for some reasons.

So what are the reasons that attract you to JOSM?

I think the possibilities of using some tools, plug-ins and something like that are very simple and there are many many tools such as adding points into pass and so on, it's a very very simple tool to work with JOSM. Potlatch I have many problems to do some simple tasks like cutting ways or something like that or make building rectangle or something like that. In JOSM you have to type the key R and so the shape becomes a rectangle and it's a very simple way. In Potlatch I have to search all these functions to see if they even exist.

What were your opinions of the task manager during Haiyan?

Basically it's a very nice one. As a user I knew what to do in a relatively fast way and the thing that you can do is cut your working into smaller pieces. This is a very nice feature and the reservation of the typing areas are very nice. Sometimes I had some problems with the loading time of the task manager, so sometimes I had to wait a long time.

Did you think that it could be improved in any specific way?

I used the default version and overall it was fine I think apart from loading times.

When you first used OSM, did you have to be trained or did you learn yourself?

I learned all by myself. There was some little things that are solved by the community forums etc. but the main things I learned by myself.

Have you attended any mapping parties?

I attended one mapping in Berlin where I'm living. It was the mapping party for the mapathon in the USA last year, in February. I think in the mapping party I was the most motivated person in the party. I had 10,000 contributions during, I don't know, 10 hours or something like that and the other people I don't know, they went to have a look at OSM, so it was more a newbie event than a real mapping party. It's okay for me, I wanted to show the people OSM and the people came to the party to learn it, but only a few people mapped in that mapping party.

Okay great, you briefly mentioned that you don't know how you mapped during Haiyan. Are you aware of any of the validation processes that are in OSM?

I know that but it's the same thing for all mappers that validate your contributions. So they validate it with a view of the satellite picture like the person who mapped it. So most of them don't even know if the building exists. Even they can't be sure. I had a case where I found something that was wrong so I corrected that and changed the work of somebody else. I can't remember what it was. I remember some buildings and areas where definitely no buildings or areas exist, and streets that don't exist on any imagery.

Okay. Are you aware of the role that OSM plays on social media?

I'm a follower of the OSM Twitter account, but only the German one. I don't know about the role that it played, I really can't say anything about it. I don't know how much followers the Twitter account has. I don't know, I think in my opinion the German region, the German OSM forum has the most contribution to the HOT team. There was many users who contributed to the HOT team. I think that was a very very important platform for recruiting for Haiyan, I remember now.

Okay, moving onto the satellite imagery, could you please tell me your thoughts on the imagery? Are you aware of the imagery petition circulated by some members of HOT?

I'm not aware of that. The main problems I had was the colour wasn't very clear. I don't know it's because of the weather, it was something like grey or brown and it was hard to decide is there woods or is there a field, or is there a path, a track or something like that. The other problem were that there was many clouds over some areas so you couldn't see the things behind the clouds.

Have you been following any new technologies that might provide imagery?

I have heard of drones but I don't see any usable imagery yet from it, so I can't say anything about it. I follow some discussions in the German OSM forum, but especially for Haiyan, I don't know anything about it.

You said that you did most of your mapping in Tacloban? Is there any reason for this?

It was a random thing. I looked at the HOT area and took that area where I think there was a high population area and so the results are most important for the work, so I decided to choose a town or city, so I contributed randomly to Tacloban. There was no other decisions for it. I don't know but I think in Tacloban there was very fast results, you could see the results of the HOT projects, you could see the results very fast, it was more interesting to see the work in Tacloban than in the woods or fields or in the middle nowhere. So that's why I think Tacloban was chosen because a larger contribution could be made.

Understanding more about the impact that you think crowdmapping is having, did you follow the impact that the maps were having on the ground?

Just a little bit. I don't know really the exact impact the map really had, but I know from a HOT project in Haiti that the rescue teams really needed the maps for their Garmin devices, so I hope that Haiyan has the same affect for the ground teams.

Is something that you think you might like to be informed of by the HOT team?

It would very nice to hear what the data is used for, but I don't know if there any article or information existing, I know from the Haiti project that there was really fast information, I don't know if something like this exists for Haiyan. But I would like to read something like that. I think they could have done that.

So if I ask to you from your understanding and experience, how do you think that crowdmapping helped during Haiyan?

I really can't answer that, I don't know the real results of the crowdmapping, but for me it's an ideological way to work. I hope that crowdmapping is very effectual so to speak and believe that it is having some effect but I can't give you any measured thing to say that it is.

Okay great [anonymous], that's everything that I wanted to ask you. Thank you very much for your time today. Please do keep in touch and it was a pleasure to speak you.

I just want to say it's a very nice project, it's very nice work you are doing. I think it could be a very important work. Do you plan to publish your results?

Yes, that is the ultimate plan, thank you. I will definitely share my findings with you as are playing an important part in it. So thank you.

Thank you, speak to you soon.

Sure, take care, bye.

Bye.

Appendix 5 – Data Analysis Descriptive Codes

The 91 initial descriptive codes consisted of issues, events, and topics that arose from the data collection.

Community-Level Codes (OSM Contributors)

1) Mapping Processes
2) Mapping Motivations
3) Mapping Expectations
4) Mapping Feedback
5) Mapping Conflicts
6) Professional Life Influence on Mapping
7) Damage Assessment Report
8) Number of Contributions/Time Spent on Mapping
9) Previous Mapping History/Experience/Disaster Mapping Experience
10) Other Humanitarian Work during Haiyan, other than Mapping
11) Previous Humanitarian Experience other than Mapping
12) OSM Introduction
13) Activation Structure
14) Technologies Involved (Editors)
15) Technologies Involved (Tasking Manager)
16) Technologies Involved (General)
17) Other Mapping Tools
18) Training
19) Validation
20) Communication (Mailing List)
21) Communication (IRC)
22) Communication (General)
23) Communication (With anyone in Philippines)
24) Mapping Parties/Mapathons
25) Role of Social Media
26) Satellite Imagery (Opinions, Thoughts)
27) Why Tacloban?
28) Petition
29) Geographical Areas Contributed Towards
30) Impact of Crowdmapping
31) Further Issues

Organisational-Level Codes

32) Imagery Coordination Tool/Group
33) Philippines Government
34) General

35) IMO
36) Project NOAH
37) DSWD
38) Humanitarian Organisation One
39) General
40) Technological
41) Maps Used
42) Humanitarian Organisation Two
43) General
44) Maps Used
45) Humanitarian Organisation Three
46) General
47) Technological
48) Maps Used
49) Canadian Armed Forces
50) General
51) Technological
52) Maps Used
53) DigitalGlobe
54) Disaster Management
55) Mapbox
56) HOT
57) General
58) Tasking Manager
59) General Change
60) Digital Humanitarian
61) Collaboration
62) Quicker, Faster
63) Transformation
64) Best Maps
65) Before
66) Other Major Issues
67) Petition
68) Satellite Imagery
69) Excessive Tacloban Imagery
70) Alternatives to Satellite Imagery
71) Learned from Haiti
72) Technology
73) Editors
74) General Communications
75) Mailing List
76) IRC
77) Future Activations
78) Mapping Parties/Mapathons
79) Giving Back
80) Filipino Resilience

81) Previous Disaster Management Experience, Only Mapping?
82) Why Haiyan?
83) Motivations
84) Expectations
85) Damage Assessment Report
86) Role of Social Media
87) Validation Process
88) Training
89) Filipino Involvement, Local Knowledge
90) Activation Structure
91) Further Issues

Appendix 6 – Data Analysis Themes, Concepts and Data Examples

The below table details the themes from the data, based on the descriptive codes in appendix 5, mapped to concepts of structuration theory. Moreover, the table details the corresponding section of the analysis chapter, and presents examples from the data.

<u>Main Descriptive Codes Used</u>	<u>Themes from Data</u>	<u>Concepts from Structuration Theory</u>	<u>Section of Analysis Chapter</u>	<u>Data Examples</u>
31, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 54, 59, 60, 61, 62, 63, 64, 65, 71, 77, 82, 89, 91	- Enhancing Credibility	- Signification / Meaning	- The Evolvement of the Meaning of Crowdmapping for Humanitarian Response	<p>- <i>“Haiti was perfectly aligned to the way that the OSM community can respond because the disaster was quite severe, a lot of loss of life, but also it was concentrated on a very small area of the earth’s surface, just a couple of cities, where the worst loss of life was concentrated and those cities had very poor existing mapping available. So it was absolutely ripe for the OSM community to come along and make a big difference”.</i></p> <p>- <i>“I think, for the larger humanitarian world as a whole, everyone realised after Haiti... how</i></p>

			<p><i>valuable OSM could be”.</i></p> <p><i>- “Gulu gave us a lot of confidence that, okay, we can try this in other areas”.</i></p> <p><i>- “They were like, ‘Go and do mapping’, but they were not like, ‘Go and crowdsource’, we just sort of said, ‘Okay, this seems good’, and we started doing it, and then when it sort came time to, like, ‘Oh, we should make a call whether this is good or not’, the results were so clearly good and helpful that everyone was like, ‘Oh yeah, keep with that’”.</i></p> <p><i>- “I don’t think we have to sell it anymore, it’s already sold. We did have to sell it, we had to convince people why it is valuable, but we don’t have to do that anymore, it’s proved itself. Now, crowdmapping is just part of what</i></p>
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				<p><i>we do, it's just sort of anticipated and expected that we incorporate this into our projects and our disaster response".</i></p> <p><i>- "I think Haiyan opened everyone's eyes and, now, even people that don't want to 100% understand still what OSM does recognise that we did something pretty major there and that we got good maps out of it, like some people were more understanding of how exactly that works compared with others, but they don't really have to understand that; as long as they can see it, we have a pretty strong institutional backing at this point to do this work, and to invest our time and energy into it, which is great, we proved our point".</i></p>
1, 5, 7, 26, 28, 31, 32, 53, 55, 67, 68, 69, 70, 79, 80, 85, 91	- The role of the crowd	- Domination - Knowledgeability	- Challenging the Domination over Resources	- "What we initially thought and what had kind of been

	<ul style="list-style-type: none"> - Crowd conflicts - Control 	<ul style="list-style-type: none"> - Reflexivity - Rationalisation of Action - Dialectic of Control - Relational Power - Allocative Resources 	<p><i>reported was that there was this 30-day limitation, so we thought, 'Well, that's kind of a dumb thing to do, I mean we might be six months from now and they will still be rebuilding and what if we find some area that we missed and we want to go back and handle this'. So, we thought, 'Why do we have to be limited to these images and this 30-day window?'".</i></p> <p><i>- "And then it came out, later, that, 'What we mean is that, for 30 days, we will grant imagery requests for new imagery, but the existing requested imagery that we have put up will still be available.' That was a big source of the animosity too with this petition and whatnot, because we kind of misunderstood what was meant by that 30-day issue. It was, like I said, a big misunderstanding</i></p>
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			<p><i>on both sides and so it just kind of spiralled from there”.</i></p> <p><i>- “I think it somehow ruffled a lot of people and concerned some imagery providers because some of the opinions were asking them to provide us with this kind of imagery, and it is not really their mandate to give us that imagery. It was like we were somehow demanding, the petition somehow demands them to do such and such; but this is..., some people believe that they give it out of charity, out of concern but not really, it’s not really for us to demand from the imagery provider’s access to the data”.</i></p> <p><i>- “We intend to work in policy around drones, because there are considerations you need to make, we spend a lot of time when we are doing mapping situating</i></p>
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			<p><i>ourselves within the local context, understanding the local communities and explaining what we are doing, making sure that what gets collected and produced is shared back and that same kind of consideration is needed with drone imagery and as it is a newer thing for us, we need to think it through”.</i></p> <p><i>- “We realised that, with all the different organisations now involved in these sort of situations, there needs to be a coordination tool, and that’s where the coordination tool came about”.</i></p> <p><i>- “It’s been a lot more effective to coordinate things between everyone. We were able to get certain imagery at no cost through the imagery coordination group . . . We were able to get it free and, actually,</i></p>
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				<i>probably in a timelier manner than going through a purchasing process”.</i>
20, 21, 22, 24, 25, 31, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 54, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 72, 73, 74, 75, 76, 78, 86, 91	- Gaining Legitimacy	- Legitimation	- The Emergence of the Legitimation of Crowdmapping for Humanitarian Response	<p><i>- “The HOT team do have a validation process . . . they have people that do the initial data collection or digitisation, and then they have more experienced volunteers who come in and do validation, so we pretty much rely on what they do”.</i></p> <p><i>- “We sent out emails to students from former years and said, ‘Look, every lunch time for two hours for the next week, we will be meeting, the department will pay for lunch . . . come in and help us map Haiyan.’ So, rather than it being one big 100 people session, which usually we would have in conjunction with the class rooms, the Haiyan mapathon was kind of strung out over a week, whereby people</i></p>

			<p>would show up, hang out, have lunch, like a lot of faculty did too. They would just bring their lunch into our lab and everyone would hang out, we would put on some tunes or whatever, people would talk and we would work on whatever tasks”.</p> <p>- “I think that we learned that we need to develop better technical tools to work with OSM at that scale and, this way, like, we have been focussing a lot on drumming up the money and the coalitions, we need to work better with the field, we need our field responders to better understand what we do and the possibilities of it because, sometimes, we are just throwing stuff at the wall and seeing what sticks . . . that was one thing that I learned, and we want better technical tools so that we can meet</p>
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			<p><i>demands better, so we are really working on ways that we can get offline OSM . . . like, we want those tools to be part of what we do and have ways to push them out to our responders and really give them the confidence, give them the best possible thing”.</i></p> <p><i>- “The mapping technology has come to a place where now we can see the outlines of how that would work; we just need to sit down and knuckle down and do it. We are kind of excited to work that out because I think that it will be a really major advance”.</i></p> <p><i>- “We couldn’t prioritise tasks; now, when you have tasks on there, you can have high, urgent, medium. What we found was, sort of, that, whatever task was on top, tasks would just get dropped on it sequentially and</i></p>
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				<p><i>people would just take . . . so there wasn't, like, a clear system for assigning things, and also even within a task, even, for example, for Tacloban tasks, I wanted the inner city mapped first, but people were nibbling at the edges".</i></p> <p><i>- "Well, we helped fund the tasking manager improvements so I think they are awesome (laughs). It just makes things much easier, that's the constant sort of ethos of this, we are never satisfied with the tools, and we are never satisfied with the quality of the map, so we are just going to keep advancing those over and over".</i></p>
<p>1, 3, 4, 5, 8, 9, 13, 14, 15, 16, 18, 19, 27, 30, 31, 66, 83, 84, 87, 88, 90, 91</p>	<ul style="list-style-type: none"> - Crowdmapping Challenges - Crowdmapping management - Crowd ambiguity 	<ul style="list-style-type: none"> - Knowledgeability - Reflexivity - Rationalisation of Action 	<ul style="list-style-type: none"> - Critical Issues Facing the Crowdmapping Community 	<p><i>- "What do you do if somebody has mapped a square and, say, there are 200-300 buildings in that square they have mapped, and they have missed, say, five buildings,</i></p>

				<p><i>what do you say about that, what level of omission becomes that this is unsatisfactory, is even one building missed unsatisfactory?”.</i></p> <p><i>- “Having some examples of, maybe, the general types of buildings could help a lot. Having some training so you can see, for example, that’s the kind of typical buildings for... I don’t know, for farms; so you can look at these kinds of buildings and you will know how to map them when you see them again. So, maybe some kind of training samples or samples that are verified by some locals and you can go there and see the data”.</i></p> <p><i>- “To be honest, I don’t know how they were being used. I know that the aid agencies did contact OSM and asked them to do it, so I did it”.</i></p>
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				<p>- <i>"I think I can't say this because I don't know the reality. So I don't know if that thing I mapped is as a building or a path, is really a path or a building, or is still existing, so I can say, for me, that I did my best to decide the right thing but I can't say that if it was really a good job I did or not".</i></p> <p>- <i>"Certainly, I would love to hear, 'Oh, hey, yeah, that was great', or, 'That was terrible', I think, yeah, feedback would be good. A little bit of feedback would be good".</i></p> <p>- <i>"Maybe one email or something at the end of the activation to say, 'Okay, you did this and it was this good', or something like this".</i></p>
2, 3, 9, 10, 11, 81	<ul style="list-style-type: none"> - Crowd eagerness-to-know - Crowd monitoring of results 	<ul style="list-style-type: none"> - Knowledgeability - Reflexivity - Rationalisation of Action 	- Profile of Crowdmapping Community	<p>- <i>"I read a couple of articles about it but I'm still kind of not sure. I hope right, it was having some effect, I would like</i></p>

	<p>- Crowd interest in results</p>		<p><i>to have more information on this but I think generally the use is to coordinate”.</i></p> <p>- <i>“What motivated me was to be able to help from a distance, because normally you see a disaster somewhere in the world on TV, and you say how terrible it is and maybe do some fundraising but most often that is it. In this situation, I could actually help because I have a lot of mapping experience and I could actually help from a distance to hopefully give a little bit of comfort to the people there”.</i></p> <p>- <i>“I think that is a combination of relaxing work or a hobby, and at the same time as I think I myself I experience it as being useful to others”.</i></p> <p>- <i>“I think it was pretty much described for</i></p>
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				<p><i>every single task what was expected. So basically, there was a description of the task and I think the expected thing was that you try to fulfil this task as best as you can. Yes, I think that's what was expected".</i></p> <p><i>- "I suppose there are some qualities or rules, well it's not only quality but also there is a set of rules that you have to follow to map like the keys or values we can use, well I guess its basic knowledge if you are an editor for a while".</i></p> <p><i>- "no, only mapping. Just mapping".</i></p>
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