

A CONTEXT-AWARE COLLABORATIVE DECISION MAKING FRAMEWORK FOR COMBATING TERRORISM IN AFRICA

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Date: 19th June 2020

A thesis submitted in fulfilment of the requirements for the Degree of


DOCTOR OF PHILOSOPHY

in the School of Management Sciences

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Abstract

Collaborative Decision Making (CDM) is a never-ending challenge in complex-problem situations where multiple actors are involved. Complex-problem situations involve problems that are ill-defined, ill-structured and wicked such as terrorism. Problems of this nature usually warrant a collaborative effort between actors (organizations) with multiple skill-sets and expertise that at times might be at variance with each other. In order to address this gap, three sub-objectives were postulated from the main research objective, “To determine how optimal/effective CDM can be realized amongst counter-terrorism organizations through context-aware technologies.”

Using the theory of synergetics and following deductive thematic analysis, the socio-technical nature of the terrorism problem was depicted by postulating a Digital Terrorism Ecology that consists of Open Digital Infrastructure (ODI), Digital Information Ecosystem (DIE), Digital Terrorism Enactment (DTE), Digital Capability and Digital Enslavement. Based on institutional theory and using PLS-SEM technique, Group/departmental relationships, Organizational co-operation, Organizational form, Technical infrastructure and inter-operability, Information and knowledge sharing were identified as the factors influencing attainment of Optimal/effective CDM amongst counter-terrorism organizations. In order to explicate the role of context-aware technologies in enhancing CDM amongst counter-terrorism organizations, a context-aware CDM framework was developed following Design Science Research (DSR) methodology.

In this study it was evident from the findings that attainment of OCDM in counter-terrorism contexts is challenging even though it is essential. Among the factors considered as possible influencers of attainment of OCDM, Organizational form (OF) was found to influence Organizational cooperation (OC) and Technical infrastructure and inter-operability (TI). Group/departmental relationships (GDR) were found to influence OF and OC. TI was found to influence OC and GDR and further, Information and knowledge sharing (IKS) was found to influence Optimal/effective CDM (OCDM). Of the three pillars of institutional theory, the regulative pillar offered more insights on issues related to rules, discourse and practice and hence the challenges of OCDM attainment. Practically, this study aims to re-orient the thinking of counter-terrorism organizations by presenting the socio-technical nature of the terrorism problem as well as explicating the role of digital technologies in terrorism. **Keywords:** Collaborative Decision Making, Context-Awareness, Terrorism, Context-Aware Technologies, Africa

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List of Abbreviations

AI - Artificial Intelligence

AU - African Union

AVE - Average Variance Extracted

CA-CDMF - Context-Aware Collaborative Decision Making Framework

CAD - Computer Aided Design

CAM - Computer Assisted modelling

CATWOE - Customers, Actors, Transformation, World view, Owners, Environment

CB - SEM- Covariance Based Structural Equation Modelling

CCTV - Closed Circuit Television Systems

CDM - Collaborative Decision Making

CI - Collective Intelligence

CID - Criminal Investigation Department

DM - Decision Making

DI – Digital Enslavement

DIE - Digital Information Ecosystem

DSR - Design Science Research

DTE - Digital Terrorism Ecology

DR - Design Research

DT - Digital Technologies

EAC - East African Community

EFA- Explanatory Factor Analysis

EU - European Union

FBI - Federal Bureau of Investigation

FDNY- New York City Fire Department

GDP - Gross Domestic Product

GDR- Group and Departmental relationships

GPS- Geographical Positioning Systems

HCI- Human Computer Interactions

ICT- Information and Communication Technologies

IKS - Information and Knowledge Sharing

IT- Information Technology

IS - Information Systems

ISIS - Islamic State of Iraq and Syria

IOT - Internet of Things

KMO - Kaiser-Meyer-Olkin Test

NGO - Non-Governmental Organizations

NIS - National Intelligence Service

NYPD - New York Police Department

OC - Organizational Co-operation

OCDM - Optimal Collaborative Decision Making

ODI - Open Digital Infrastructure

OF - Organizational Form

OMB - Office of Management and Budget

OLS - Ordinary Least Squares

OR - Operation Research

PLS-SEM - Partial Least Squares Structural Equation Modelling

PSM - Problem Structuring Methods

SEM - Structural Equation Modelling

SSM - Soft Systems Methodology

TA - Thematic Analysis


TI - Technical Infrastructure and Inter-operability

UN - United Nations

USA - United States of America

Declaration

I Nancy Achieng Odhiambo, student no, 18018329, hereby declare that this thesis titled “*A context-aware collaborative decision making framework for combating terrorism in Africa*” submitted at University of Venda, for a Doctor of Philosophy degree has not been previously submitted as a degree in this or any other university, and that it is my own work in design and execution and that all reference material contained therein has been duly acknowledged.

Signature: 

Name: Nancy Achieng Odhiambo

Student no: 18018329

Date: 19th June 2020

Dedication

To the memory of my daddy, Henry Odhiambo Opiyo

With love and pride:

To my mother, Jane Anyango Odhiambo

To my husband, Dr. Cecil Naphataly Moro Ouma

To my son, Atticus Henry Ouma Moro

To my sister, Violet Akinyi Odhiambo

To my brothers, Reagan, Fedel and Fehr Ochieng Odhiambo

Acknowledgements

To the Almighty God, your presence throughout this tough process has made this a reality.

To my promoter: Prof Nixon Muganda Ochara and Co-promoter: Prof Armstrong Kadyamatimba thanks so much for guiding me through this process. Without your assistance throughout this long journey I couldn't have made it.

To my lovely husband Cecil, thanks so much for always being there and encouraging me throughout this long and tiring journey. Thanks dear for being so understanding and encouraging throughout this tough process. Without you dear this doctorate degree could have not been realised. Asante sana (Thank you).

To my son Atticus, thanks dear for being understanding and giving mum time to work on this project while watching *walking with dinosaurs*.

To Kajal Kotecha, Alice Ikuzwe, Ester Mueni, Patman Owili and Brenda Okongo thanks so much friends for always being there and encouraging me towards this long journey. The journey wasn't easy to come to an end and without the continuous encouragements; I could have not made it.

To my mum (Jane), my parents in laws (Joshua and Joan), my sister (Violet) and my brothers (Reagan, Fedel and Ferh) thanks so much guys for always keeping me on my toes by always asking when the project will come to an end. Without your continuous support and encouragements, I could have not made it. Asante Sana (Thank you).

To the participants in the survey and the focus group interviews am so grateful.

Finally, to the University of Venda thank you for the support granted to me during this PhD process.

Chapter 1: Introduction

This Chapter outlines the background to the study in Section 1.1, followed by the context of the study in Section 1.2. Section 1.3 provides the research problem followed by the primary and specific research questions in Section 1.4. This is then followed by research objectives in Section 1.5. In Sections 1.6, 1.7, 1.8 and 1.9, the significance of the study, delimitations of the study, the key concepts in the study and the thesis outline are presented respectively.

1.1 BACKGROUND

Decision Making (DM) involves the identification and selection of options that depends on the nature of the problem and the decision maker (Arnott & Pervan, 2012; Harris, 1998). A decision maker's attitude, knowledge, values, preferences and role in an organization can further complicate the DM process. However, due to the nature of problems within organisations, DM usually involves input from multiple internal and external decision makers who have different opinions, characters and roles within the organisation (Lunenburg, 2010a; Owen, 2015). Hence the need for a participatory process, collaborative decision making (CDM), amongst the involved decision makers (Owen, 2015).

1.1.1 Collaborative Decision Making

Collaborative decision making (CDM), according to Owen (2015) is a participatory process which involves multiple decision makers acting collectively as one, to analyze a problem situation, to evaluate and consider alternative course of action. In CDM, unlike group decision making (GDM) where the ultimate goal is to arrive at a solution, through a process of aggregating each decision maker's understanding of the problem situation, the objective is to arrive at a significantly valuable choice than the alternatives envisioned decision makers themselves (Owen, 2015). In other words, the goal of CDM is to arrive at a solution through a process of aggregating each of the decision makers' understanding of the problem situation. In literature, CDM is presented as one of the methods essential in addressing "wicked" problems (Hazelton, Gillin, Kerr, Kitson, & Lindsay, 2019; McGlashan, de la Haye, Wang, & Allender, 2019). Wickedness as described by Rittel & Webber (1973) are

those problems which are complex, messy, ill-defined and ill-structured and hence, the reason for adopting CDM in the case of terrorism in the current study.

1.1.2 Wicked Problems

The ever-evolving social dynamics that can be attributed to rapid advances in technology and ever-expanding digital space has brought with it new challenges and problems that are ill-structured, ill-defined, time constrained and messy (*wicked*). The term wicked has been used in policy design (Turnbull & Hoppe, 2019), information science, business (Fodness, 2015) and information systems (McCarthy, O’Raghallaigh, Fitzgerald, & Adam, 2018) amongst others to refer to complex problems that are complex in nature. For instance, the rapid increase in population growth, the emergence of new technologies and globalization has resulted in numerous challenges and opportunities to the society (e.g. terrorism, global warming and poverty) and to organizations (e.g. increased competitiveness, changes in business environment and increased travel costs) (Adla, Nacet, & Ould-Mahraz, 2012; Heslin, 2009; Jung, Schneider, & Valacich, 2010; Turban, Liang, & Wu, 2011). To address these challenges, organizations and governments are compelled to bring multiple decision makers together from different organizations with different experiences, skills and creativity, regardless of their geographical location, to jointly work together collaboratively to address these “*wicked*” problems (Jung et al., 2010).

Even though, wicked problem solution calls for CDM, CDM itself is plagued by differences in perspectives, opinions, frame(s) of reference and attitude of the decision makers tasked in solving the problem (Lunenburg, 2010b; Owen, 2015). However, the decision makers in the group jointly have to collaboratively understand each other’s differences so as to arrive at a consensus through extensive communication, collaborative cogitation, debating, negotiations and knowledge sharing (Owen, 2015).

1.1.3 Digital Technologies

Digital technologies (e.g. mobile phones, personal digital assistance, Internet and Intranet) may facilitate knowledge sharing, knowledge elicitation, knowledge construction with the goal of consensus building in situations where multiple decision makers are involved and are situated, either in the same or different geographical locations (Beers, Kirschner, den Bossche, & Gijsselaers, n.d.; Desanctis & Gallupe, 1987; Seguy, Noyes, & Clermont, 2010). This is because digital technologies are

transforming the *modus operandi* of modern day organizations by introducing new concepts such as collaborative work, e-government, e-service and knowledge sharing (Seguy et al., 2010). Equally, advances in computing and communication technologies have also allowed businesses and organizations to become more distributed and dynamic in nature (DeSanctis & Gallupe, 1984; Kim, Godbole, Huang, Panchadhar, & Smari, 2004). The spread and dynamism have created some changes in the way organizations function, operate, and also how employees co-ordinate, communicate and co-operate within and across organizations (Kim et al., 2004). Likewise, the advances in computing have led to new forms of agile and dynamic collaboration.

Multiple decision makers' today, independent of their geographical location, are able to interact with one another globally to harness knowledge resources and leverage collective intelligence and social creativity across organizational and work group boundaries for improved decision making (Anya, Tawfik, Nagar, & Amin, 2010). Further, the presence and increase in penetration of mobile devices in the world today have also greatly influenced CDM processes. In today's group work environment, decision makers can utilize the mobile computing devices (e.g. smart phones, smart watches, tablets and laptops) as a means of communication and collaboration. These mobile devices are equipped with multitude sophisticated sensors such as GPS, camera, Wi-Fi, SMS etc. that enable them to be context-aware (de Matos, Amaral, & Hessel, 2017; Dey & Häkkinen, 2008; Gellersen, Schmidt, & Beigl, 2002).

1.1.4 Context-Awareness

Context-awareness is the ability of a device to detect and analyze data related to objects/subjects, the device itself and from the environment in which both the consumer and the device are situated (Dey & Abowd, 1999). It is this ability of context-aware devices that allows them to adapt their functionality and hence making them useful in the accomplishment of critical and time sensitive tasks such as information dissemination and sharing amongst several decision makers (Gross, 2015). Context in context-awareness is any information that can be used to characterize the situation of an entity which can be a person, a place or an object (Dey & Abowd, 1999; Schilit & Theimer, 1994). Nevertheless, for CDM to be effective, in complex-problem situations such as terrorism, context-aware devices are crucial and hence, the importance of this study.

1.2 CONTEXT OF THE STUDY

The rise of globalization, advancements and marked improvements in digital technologies, economic inequalities, political exclusivity and exclusion (isolation) is nurturing a fertile environment for uprisings, revolutions and political instability, all of which are conduits for terrorism and its associated ills (Kapucu, 2017; START, 2016). The African continent is plagued by poor governance which is the root of: political instability; non-transparent resource management; election malpractices; multifarious “ungoverned spaces”; and unresolved “national questions”, which have led to safe havens and training bases for groups carrying out terrorism activities both within and outside African borders. Therefore, terrorism seems to have a greater chance of blossoming in Africa (Kagwanja, 2006; Meierrieks & Gries, 2013).

This therefore calls for targeted interventions geared towards mitigating or averting the impacts of terrorism in these already fragile economies in Africa. This is because African states, most of which are still developing, are prone to economic consequences resulting from terrorism such as: loss of Foreign Direct Investments (FDI); trade loses; reduced economic growth; reduction in tourism; and higher insurance premiums amongst others (Abadie & Gardeazabal, 2003; Nitsch & Schumacher, 2004; Sandler, Arce, & Enders, 2008).

This study considers three African countries namely Kenya, Nigeria and South Africa. Kenya was considered because of the recent terrorist attacks such as Garissa University attack, the Westgate Mall attack and the DusitD2 attacks as well as its geographical position within the East African community and trade. Nigeria was considered because it is one of the major economies in Africa as well as having suffered from terrorism related events in Yobe, Maiguri, and Kaduna amongst others. South Africa was considered because like Nigeria it is one of Africa’s major economies with significant advancement in ICT as was reported in the case of Westgate attacks in Kenya it can be a fertile ground for recruiting terrorists and terrorism related funding. In the subsequent sub-sections a background on the three African countries considered in this study is given.

1.2.1 Kenya

Kenya is a country in East Africa and borders Ethiopia, Tanzania, Uganda, Somalia and Sudan to the North, South, West, East and North-West respectively (see

Figure 1-1). It covers 580,367 square kilometers and has a population of approximately 52 million (2019) with most of its population living in the rural areas (75.6%) (“World Population Review,” 2019). Its population growth rate is at 2.7% per annum with a life expectancy of 60.4 years. There are more than 40 ethnic groups in Kenya with agriculture, service industry and tourism as Kenya’s main economic activities (“World Population Review,” 2019). Nairobi is the capital city of Kenya with Kiswahili and English as the official languages and the Kenyan shilling as its currency. Religion in the country is a mixed- Protestants, Catholic, Hindus, Muslims and Traditional beliefs.

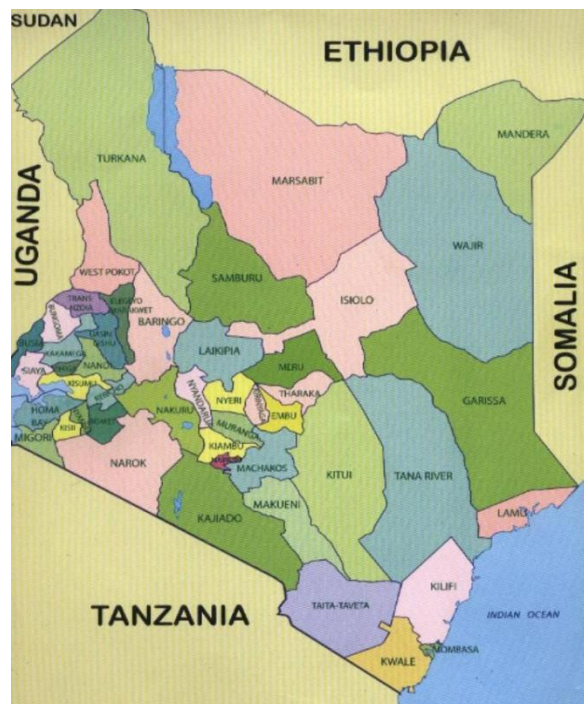


Figure 1-1: Map of Kenya (source: Facts, 2015)

1.2.1.1 Economy

Kenya has the largest and the most diversified economy within the East African Community (EAC). Even though, Kenya has a growing entrepreneurial middle class and steady growth, its economic development has been impaired by weak governance and corruption. Agriculture and tourism holds an important place in Kenya’s economy however, the tourism industry has been hard hit by incidences of terrorism experienced over the past decade (“Kenya Economy 2019,” 2019; *KPMG BurgetBrief*, 2015) (“Kenya Economy 2019,”; *KPMG BurgetBrief*, 2015).

1.2.1.2 Security

Kenya is continuously and frequently on the news following deadly attacks by the radical Islamic group (al-Shabaab). The increase of attacks since 2011 in Kenya is associated with the country being part of peace keeping mission by the AU in Somalia (AMISON) (“Kenya Economy 2019,” 2019). The 1998 bombing of the US embassy, highlighted the presence of radical Islamists group in the country and their presence has already mentioned above, has hit the Kenyan tourism industry leading to closure of most tourists’ facilities at the Kenyan Coast. This has had a negative impact on the sectors which supplied goods for tourists consumption such as agriculture, manufacturing and transport (*KPMG BurgetBrief*, 2015). Even though, al-Shabaab incidences accounts for only 9% of the total fatalities in Kenya as from 2008, the rise in the intensity of the attacks has made the group more lethal for Kenya.

1.2.2 Nigeria

Nigeria (Africa’s most populous country) is located in the Western Coast of Africa and covers an area of 923,768 km² (Echefu & Akpofure, 2002). Nigeria borders Niger to the north, Cameroon and Chad to the east, Gulf of Guinea to the South and Benin to the West (see Figure 1-2). The population is approximately 200 million with half of the population living in the rural areas (“World Population Review,” 2019). There are estimated more than 250 ethnic groups in Nigeria with the major ethnic groups including the Hausa/Fulani (between 35-40 million), the Yoruba (30 million) and the Igbo (15 million). The languages spoken in Nigeria can be group into three major categories: Niger-Congo, Nilo-Saharan and Afro-Asiatic (Falola et al., 2019). English is the mode of instruction in academic institutions, business and government. Figure 1-2 illustrates the map of Nigeria.

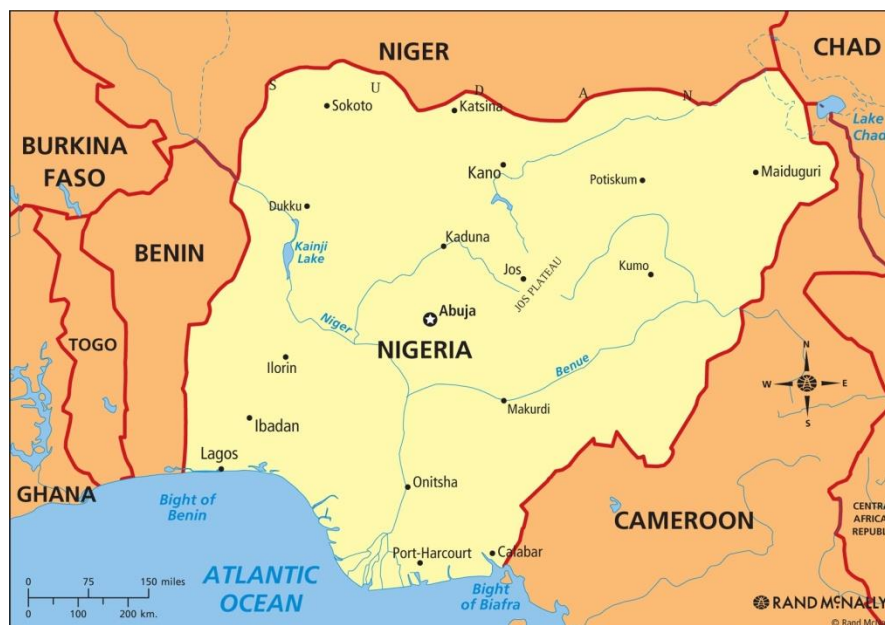


Figure 1-2: Map of Nigeria (Source: Lynch, 2015)

1.2.2.1 Economy

Nigeria has one of the largest economies in Africa that is mainly anchored on petroleum. Prior to oil, Nigerian economy relied on agriculture (before 1970) however, this sector was neglected due to over reliance on oil making Nigeria a mono-economy fully dependent on its huge crude oil deposits (Echefu & Akpofure, 2002). Like many African States, corruption and poor governance has severely deterred the economic development of the country (Suberu, Ajala, Akande, & Olure-Bank, 2015).

1.2.2.2 Security

The country is experiencing serious security challenges. Notable security threats include the terrorists' attacks in the northern parts of Nigeria (Adegoke, 2014). This according to (Achumba, Ighomereho, & Akpor-Robaro, 2013) has led the government to increase the national security budget to curb the increasing incidences of violent crimes such as terrorism, kidnapping, armed robbery and banditry, suicide bombing, religious killing, ethnic clashes, politically-motivated killing and other forms of criminal activities (Adegoke, 2014).

1.2.3 South Africa

South Africa is located in the Southern part of the African continent. It covers an area of 1,221,000 km² and borders Zimbabwe, Botswana, Mozambique, Namibia, Swaziland and surrounds the Kingdom of Lesotho. The population is approximately

56.5 million with 63% of the population in urban areas (“Index of Economic Freedom,” 2019; Worldometers, 2017). South Africa is one of the richest countries in terms of mineral resources (iron ore, gold, diamond, coal and platinum) and has more than 10 ethnic groups and the spoken languages are English, Afrikaans, Zulu, Venda and Xhosa amongst others (“South Africa Economic History,” 2019.). Its administrative, judicial and legislative capitals are Pretoria, Bloemfontein and Cape-Town respectively. Figure 1.3 illustrates the map of South Africa and the neighboring countries.



Figure 1-3: Map of South Africa (Source: Operation World, 2019)

1.2.3.1 Economy

South Africa has a highly developed economy and advanced economic infrastructure. The country is one of the largest producers and exporters of gold and platinum. South Africa has well developed financial, legal, communication, energy and transport sectors as well as the Africa’s largest stock exchange. The country has one of the largest Information and Communication Technology (ICT) markets in Africa by value. It shows technological leadership in the mobile software field, security software as well as electronic banking system services. In other words, ICT is one of the country’s important contributors to its GDP (“South Africa-Information Tenology,” 2018).

1.2.3.2 Security

South Africa is one of the countries in the African continent that can be termed lucky when it comes to terrorism related incidences. However, just like any other

country in the continent, South Africa is also plagued with challenges that might put the country at a risk to terrorism (“Terrorists activities in the Southern part of Africa are likely to increase its footprint,” 2013). Xenophobia, racism, poverty, extremism, grievances, corruption, porous and insecure borders are some of the factors that can fuel the growth and spread of terrorism in the country (Cilliers, 2003; Harbeson & Lyman, 2007; Rosand & Ipe, 2008). Therefore, targeted interventions to terrorism are needed.

1.3 PROBLEM STATEMENT

The need for collaborative decision making (CDM) in pre and post terrorism related events has been greatly underscored by the terror attacks in Africa such as the Westgate Mall attack, Garrissa University attack and DusitD2 attack in Kenya, Yobe State attacks, Kalari attack, Madagali attacks and Borno State attacks in Nigeria (CNN, 2019; Africa News, 2019; CBS News, 2019). Equally, the recent cyber-attacks in South Africa as well acquisitions of terror funding in South Africa also brings to the fore the need for CDM in counter-terrorism (CNN, 2019). Further, individuals with South African travel documents have been associated with terror offences within and outside Africa (Institute for Security Studies, n.d.; UNODC, 2019).

The continual and incessant terror attacks in Africa may be attributed to the counter-terrorism strategies being inefficient or not being fully implemented (exploited) by all the agencies involved hence the need for CDM (Beri, 2017). Chen et al., (2000) and Musumba (2013) propose that context-aware technologies (e.g. mobile devices) could be handy in successful implementation of CDM processes in situations where there is need for information to be relayed, shared or both amongst multiple decision makers within the same and different geographical locations as in the case amongst counter-terrorism organizations. The use of context-aware technologies could be applied in various ways to enhance decision making in combating terrorism. The underlying hypothesis being that: Context-aware technologies can be incorporated as part of a CDM framework for effective counter-terrorism practices amongst the government, the non-governmental organizations and the security agencies involved.

1.4 AIM AND RESEARCH OBJECTIVES

The aim of this study was to create a framework that can aid attainment of optimal/effective CDM amongst counter-terrorism stakeholders with the help of context-aware technologies. Hence the objective:

To determine how optimal/effective CDM can be realized amongst counter-terrorism organizations through context-aware technologies

To address this aim, the following specific research objectives were postulated:

- i. To assess the effectiveness of systems thinking in structuring the terrorism problem in the digital age.
- ii. To determine the key factors influencing collaboration in decision making amongst counter-terrorism stakeholders.
- iii. To establish how context-aware technologies can be used in enhancing CDM amongst stakeholders involved in counter-terrorism.

1.5 RESEARCH QUESTIONS

The primary research question addressed in this study was:

How can optimal/effective CDM be realized within the context of terrorism through context-aware technologies?

To address this primary research question, the following specific research questions are posed:

- i. How can the terrorism problem be structured in the digital age?
- ii. What are the key factors influencing collaboration in decision making amongst stakeholders involved in counter-terrorism?
- iii. How can context-aware technologies be used in enhancing CDM amongst stakeholders involved in counter-terrorism?

1.6 SIGNIFICANCE OF THE STUDY

This study is aimed at several groups. Scholars interested in Information Systems (IS), decision sciences and terrorism studies. Scholars interested in African studies and developing countries as well as digital technologies, will find value on the discussions

presented in this thesis. Equally, counter-terrorism organizations, decision makers and policy makers may also find value from this thesis by utilizing the developed framework in their day to day decision making activities.

Theoretically, this study presents a way in which concepts from two different theories (theory of synergetics and institutional theory) can be integrated in understanding and investigating complex-problem situations. Methodologically, the study shows a way in which mixed method approach can be used in complex problem investigation. In addition, the study presents the efficacy of DSR in framework development. Practically, the study provides both scholars and practitioners with a framework that can be of use in CDM practices. The framework consists of several concepts and components that can be essential for the implementation of CDM initiatives in not only the organizations but also in the society.

1.7 DELIMITATIONS OF THE STUDY

This study focuses on CDM amongst agencies involved with counter-terrorism with the aim of developing a framework (CA-CDM) that can be used to facilitate collaborative efforts amongst them. This study is limited to Kenya, Nigeria and South-Africa and the focus is restricted to the following concepts (collaboration, CDM, context-awareness and terrorism). Legal aspects are outside the scope of this study.

1.8 DEFINATION OF CONCEPTS

This research study consists of a number of key concepts which includes: decision making, collaboration, collaborative decision making, context, context-awareness and terrorism. The terms are defined as follows:

- **Decision Making** - Harris (1998) describes Decision Making (DM) as a process which involves identification and selection of options based on the values and preferences of the decision maker. March (1994) on the other hand refers to DM as a process of choosing from amongst alternatives. According to Baker et al., (2002), DM is an important part of planning and should commence with identification of the stakeholder (s) and the decision maker (s) so as to avoid possible disagreements that can erupt latter concerning the definition of the problem, goals, criteria and requirements.

In this study, DM is defined as a judgmental choice amongst alternatives based on the decision maker's preferences and the problem at hand.

- **Collaboration-** Collaboration is described in literature in various ways. Roschelle and Teasley (1995) refer to collaboration as the coming together by different entities to share information, plan together, execute and assess a plan with the aim of reaching a common goal. Lai (2011) states collaboration is “a mutual engagement of participants in a coordinated effort to solve a problem together” (p.2). Contrary, Callaham (2012) views collaboration as a process whereby through negotiations, extensive communication and debating, different people with different perceptive can reach a consensus to a solution of a problem. In this study, collaboration is defined as the coming together of different stakeholders and arriving at a decision (consensus) based on all of the stakeholders (decision makers) preferences.
- **Collaborative Decision Making-** Owen (2015) refers to CDM as a collective process that involves all the decision makers in a group. The process results into arrival at the most significant choice than any envisioned by any of the individual decision maker. On the other hand, Tisdall (2013) describes CDM as a process of choosing a course of action after debating between two or more members involved in the decision making process. In this study, CDM is defined as a collective process of decision making which results into arrival at an unanimous decision.
- **Context-Aware Technology-** A context-aware technology is one which has the ability to detect and analyse data related to objects/subjects, the device itself and from the environment in which both the consumer and the device are situated (Dey & Abowd, 1999; Svanaes, 2001).
- **Context-** Context is information/data that can be used to characterize an entity (e.g. a place, a person or an object) (Dey, 2001). According to Avgerou (2001), context is an important concept in Information Systems (IS) innovation that IS researchers need to consider. However, in developing countries the relation between context and IS innovation is not taken seriously. This is because IS innovations in developing countries are mostly a transfer of technology and organizational practices, originally designed

and tested useful in other socio-organizational contexts (Avgerou, 1995). Nevertheless, contextual analysis of an IS innovation should; (1) relate the innovation to socio-organizational change, (2) not only consider the local organization but also the national and international context, (3) consider the rational/technical of professional experts and managers and the institutional forces within the organization and in the environment (Avgerou, 2001).

- **Terrorism-** The terminology terrorism so far lacks a universal definition. Several authors, organizations, bodies and governments have defined the term differently and in various contexts (Ahmed, Elgazzar, & Hegazi, 2005; Reaves & Hickman, 1998; Sandler, 2011). Nonetheless, in this study, the term terrorism is described as an organized attack by either a group of people or an individual to an armed individuals' with the aim of causing maximum casualty or fear.

1.9 THESIS OUTLINE

The outline of this thesis is as follows:

In *Chapter One*, the background of the study as well as the problem statement, research questions and objectives are presented. In *Chapter Two* the literature review supporting the study and the theoretical framework is given. In *Chapter Three* the research methodology and design adopted in the study is provided. In *Chapter Four* structuring of the terrorism problem using systems thinking is elaborated, then in *Chapter Five* analysis of the survey data is presented. In *Chapter Six*, the finding on how context-aware technologies could be used in enhancing CDM within counter-terrorism organizations is provided and a framework is proposed and evaluated. In *Chapter Seven*, the study concludes.

Chapter 2: Literature Review

This Chapter presents related literature on the three main components of this study, CDM (Section 2.1), context-awareness (Section 2.2) and terrorism (Section 2.3), as well as the details on the two theories adopted in this study (Section 2.4). In Section 2.5 the conceptual framework is discussed followed by reflections from literature in relation to the study's objectives in Section 2.5 and the Chapter summary is presented in Section 2.6.

2.1 COLLABORATIVE DECISION MAKING

Collaborative Decision Making (CDM) is still a significant research challenge. There are several definitions of CDM in literature (Kim et al., 2004; Owen, 2015; Panzarasa, Jennings, & Norman, 2002; Seguy et al., 2010; Kapucu & Garayev, 2011). In this study, CDM is referred to as a collective process involving multiple decision makers from different organizations working together in a group with the aim of coming up with the best single solution. Rittel and Webber (1973) refer to problems whose resolution require CDM as “*wicked*”, since they are ill-structured, ill-defined and complex and therefore, their solution and mitigation require the involvement of multiple decision makers (Owen, 2015).

The increased use of CDM processes amongst policy makers, academicians and decision makers can be attributed to the increase in complex problems which calls for multi-sectoral collaborations (Jankowski & Nyerges, 2001; Löfström, 2010; Seguy et al., 2010). This is because conventional and traditional decision making approaches that were characterized by individuality, unilaterality, centralization and hierarchy are nowadays outdated (Kapucu & Garayev, 2011).

However, despite the attractiveness of CDM in complex-problem situations, its attainment is inhibited due to information overload and the complexity of current problems (Keefe & Isenberg, 2013). As multiple decision makers collectively address a set of common decision issues, through information processing, stimuli interpretations, group dynamics, communications and interactions, they need to develop a shared understanding that will lead to an effective solution (Raghu, Ramesh, & Whinston, 2005). Unfortunately, developing a shared understanding amongst

decision makers can be challenging due to a number of factors, of which some are discussed as follows:

i) Organizational Culture

Alavi, Kayworth and Leidner (2005) state that organizational culture exists in three distinct levels which include; basic assumptions, values and artifacts. The beliefs used by the organizational members to understand and arrive at decisions of ongoing events, activities and human relationships, thereby forming the basics for collective activities, falls under the basic assumptions category (Van Maanen & Barley, 1983). Values represent a more visible manifestation of culture that signifies exposed beliefs identifying what is important to a particular organizational group. Additionally, values provide a mechanism through which the members of an organization are able to interpret signals, events and issues and represent an enduring belief that a given norm or behavior is preferable over an opposite norm (Bansal, 2003). In other words, values can be seen as a set of social norms that define the rules or context for social interaction through which people act or communicate (Bell DeTienne & Jackson, 2001). Alavi et al., (2005) also states that organizational culture can manifest itself through artifacts. The artifacts being art, technology, visible and audible behavior patterns as well as myths, ceremony rituals, heroes and language. The three levels of organizational culture are important for optimal CDM processes and need to be taken into consideration because of the agency actor habits and preferences while performing their duties (Kapucu & Garayev, 2011).

ii) Organizational Structure

According to Ghani, Jayabalan and Sugumar (2002), organizational structure can be described as a formal allocation of work roles and administrative mechanisms to control and integrate work activities. The structure of an organization can take a variety of forms; centralized, simple, matrix, bureaucratic or flexible (Islam, Jasimuddin, & Hasan, 2015). A centralized organizational structure for instance, is characterized with low decentralization and operates under specific norms and regulations. Whereas, a flexible organizational structure is more open to communication and highly decentralized (Burns & Stalker, 1994). These differences in organizational structures (e.g. hierarchal, flexible, centralized) (Nooshinfard & Nemati-Anaraki, 2014; Rowley, 2011; Yang & Maxwell, 2011) have an effect on information flow and exchange, which in turn influences CDM processes. Equally, decision making processes in organizations with informal environments, high levels

of decentralization and minimized hierarchies induce employees to work as cohesive groups facilitating interpersonal communication and thus, helps in knowledge and information sharing which can facilitate optimal CDM processes.

iii) Trust

Trust-based partnerships are essential for the overall success of CDM processes in an organization (Hassan, Toylan, Semerciöz, & Aksel, 2012; Kapucu & Garayev, 2011; Martins, de Faria, Prearo, & Arruda, 2017). This is because mutual trust within and across organizations is important for information and knowledge sharing (Akbulut, Kelle, Pawlowski, Schneider, & Looney, 2009; Praditya, Dhata; Janssen, 2015). Thus, trust promotes better working partnerships and environments for different organizations and individuals working collectively in a group as collaborators (Agranoff, 2007).

Equally, trust is vital for CDM processes as it can reduce transaction costs, strengthen network ties and enable collective actions (Isett, Mergel, LeRoux, Mischen, & Rethemeyer, 2011). Unfortunately, determining the level of trust amongst the participating members/organizations in CDM process is challenging (Kapucu & Garayev, 2011). Pardo, Gil-Garcia and Burke (2008) state that clarity of roles and responsibilities, appropriate roles of authority and respect of authority could be used to build trust within and across organizations, which can thereby result in effective attainment of optimal CDM.

iv) Policy

Legislation and policy does influence sharing of information and knowledge, especially amongst organizations in the public sector and hence, can be an interference to the effectiveness of CDM processes (Gil-García & Pardo, 2005; Zhang & Dawes, 2006). Laws and regulations can have an influence on how information is shared amongst and within organizations (e.g. government agencies) and can thereby, limit CDM processes. For instance, as a result of policies and laws, sharing of sensitive information in security sectors (e.g. police, army), is highly controlled and regulated (Dawes, 1996; Zhang, Dawes, & Sarkis, 2005).

v) Digital Technologies

Digital technologies (e.g. software's, computers, mobile phones, the Internet, databases, communication systems) are considered essential enablers of CDM processes (Mat, Noor, & Mohamad, 2018; Zhang & Dawes, 2006). With the

advancements, availability and access of digital technologies, information and knowledge sharing between and across organizations is even more feasible (Mat et al., 2018; Ryan, Windsor, Ibragimova, & Prybutok, 2010; Zhang & Jasimuddin, 2012). For instance, collaborative tools such as Intranet-based systems allow people to work together and collaborate interactively (Islam et al., 2015). However, different organizations have different types and forms of hardware and software systems hence, integrating these systems of different platforms, data standards and quality can be difficult for effective CDM processes (Fedorowicz, Gogan, & Williams, 2007; Klischewski & Scholl, 2008).

vi) *Informal Relationship*

Sapadin (1988) refers to informal relationships as a deliberate connection existing mainly for pleasure and gratification and not for fulfilment of any specific function. According to Berman, West and Richter (2002), relationships (informal) that occurs at the workplace are non-exclusive and voluntary and is characterized by commitment, mutual trust, shared interest and values. Therefore, these relationships remove communication constraints by building trust and hence, good for information and knowledge sharing and promotes collective group collaboration (Amjad, Sabri, Ilyas, & Hameed, 2015; Lopes Morrison, 2005). Morrison (2004) indicates that work place relationships (informal) are mostly outcomes of inter-personal relationships. Further, Morrison (2005) claim that informal relationships are good for improving employee communication within and across organizations and can therefore influence workplace collaboration.

vii) *Leadership*

Leadership style is important for successful co-operation during CDM processes (Kapucu, 2017). There are three different forms of leadership styles that can exist within an organization; top-down, co-producer and the bottom-up (the facility style). The leadership style that enhances CDM processes is still the subject of intense debate. Co-producer leadership style has been highlighted as the best for CDM processes as it ensures good collaboration (Agranoff, 2007). The bottom-up style has been found as a reluctant leadership style when it comes to information, knowledge and resource sharing and as such not good for CDM processes (Warren, Rose, & Bergunder, 1974). The top-down leadership style has also been presented as an inhibitor to CDM processes since it encourages independent decision making (Andrews, Boyne, Law, & Walker, 2007).

2.2 CONTEXT-AWARENESS

The surge in adoption and use of digital technologies has led to improvements in computational power as well as the sensing abilities of the digital devices. A wide range of small devices with sensing and computing capabilities has taken the computational paradigm out of the desktop to portable and hand-held devices (Alegre, Augusto, & Clark, 2016). Presently, these devices are equipped with innovative mobile sensing applications that have serious implications on the users' behaviour in terms of communication and information sharing (Pérez-Torres, Torres-Huitzil, & Galeana-Zapién, 2016; Yürür et al., 2016) as well as, navigation using GPS, taking pictures, recording videos, presentation preparation, video conferencing etc. (Das, Ghosh, Jagtap, Joshi, & Finin, 2017). All these capabilities when incorporated on a device make it context-aware.

Today, information is continuously available on digital devices anytime and anywhere - a fact that has increased the appetite of building applications with sensing abilities as well as the ability to react to contextual change of the user(s) (Mizouni, Matar, Al Mahmoud, Alzahmi, & Salah, 2014). This interest in the capabilities of digital technologies specifically, in their sensing abilities, has led to an increase in innovative context-aware applications such as: recognizing user related social and cognitive activities in any situation and at any location. The inclusion of human-centric event patterns can lead to increased understanding of human (decision maker's) behaviour which in turn enhances consensus building in decision making (Bjelland & Wood, 2008; Bosse et al., 2013; Rachuri et al., 2010).

2.2.1 Understanding Context

Context is a fundamental concept in pervasive computing with no one universal definition. Several scholars including: Alshaiikh & Boughton (2013); Dey, Abowd, & Wood (1998); Perera, Zaslavsky, Christen, & Georgakopoulos (2014); Schilit, Adams, & Want (1994) define context differently. Dey, Abowd and Salber (2001) refer to context as the environmental information while Brown, Bovey and Chen (1997) describe context as computer's knowledge of the elements of the user's environment. Yürür et al., (2016) define context based on four categories: *device context*- which includes connectivity, communication cost and resources etc.; *user context*- which includes user's geographical location, user's profile and the social situation etc.; *physical context*- which includes traffic conditions, noise levels, temperature and light

etc.; and *temporal context*- which includes year, day, month and week. In this study, Dey and Abowd (1999) definition of context is adopted.

Context: Is any information that can be used to characterize an entity. An entity can be a place or object or a person or a physical location.

2.2.1.1 Definition of Context-Awareness

Attached to context is *context-awareness*, which like context also has no universal definition. One of the challenges when it comes to the definition of context-awareness according to Yürür et al., (2016) is the lack of consensus when it comes to terminology of use. The concept of context-awareness was first introduced by Mark Weiser in his seminal paper titled “*The Computers for the 21st Century*” (Weiser, 1999). Then in 1994, Schilit and Theimer provided the initial definition of the term context-awareness as a system that is able to adapt according to its location of use, the collection of nearby people and objects, as well as changes to those objects over time (Schilit & Theimer, 1994). Brown (1998) and Pascoe (1998) referred to it as a system that can sense, detect, interpret, respond to the nearby context and use the environmental information to provide the user with information and or services based on the user’s needs. Meehan, Lunney, Curran and McCaughey (2013) define context-awareness as a situation where a system is capable of using context to provide services or information to the user. However, regardless of the multiple definitions of context-awareness, this study adopts Dey (2001) definition of context-awareness:

A system is context-aware if it uses context to provide relevant information/service to the user, where relevancy depends on the user’s needs.

Dey and Häkkinä (2008) summarize three main features of context-awareness as using context to:

- Provide the user with information and services.
- Execute services to the user automatically.
- Tag information for later retrieval by the user.

2.2.2 Context-Aware Applications

Context-aware applications are applications capable of adapting their operations to the user's context based on the environmental contextual information (Baldauf, Dustdar, & Rosenberg, 2007). In general, the development of any context-aware application consists of the following three main components:

- a) *context acquisition*- gathering contextual information by sensors.;
- b) *processing*- employing reasoning techniques in order to obtain high-level contextual information (i.e. user's activities); and
- c) *acting*- providing services to the user according to his/her current situation (Vahdat-Nejad, Ramazani, Mohammadi, & Mansoor, 2016).

According to Barkhuus and Dey (2003), context-aware applications can be categorized as:

- a) *Active context-aware applications* – is a situation whereby the device automatically changes one of its application behaviour based on sensed information e.g. a mobile phone automatically changes time setting when in a different time zone.
- b) *Passive context-aware applications*- is a situation where the device based on context or sensor data provides information to the user but gives him or her an opportunity to make the change or not e.g. a mobile device prompts the user of a new time zone and allows him either to change or not.
- c) *Personalization*- is a situation where the user specifies her/his own setting on how the device should behave in a given setting.

The adoption of context-aware technologies is evident in education applications such as e-learning and virtual classrooms (Zheng, Chen, & Kong, 2017), in tourism such as navigation, e-marketing and recommender systems e.g. where to visit (Silva, Toasa, Guevara, Martinez, & Vargas, 2018), in healthcare including location of hospitals, pharmacies and specialist as well as surgery (Duc, Vinh, & Binh, 2017) and in construction management (Liu & Wang, 2017), amongst other areas. The potential for mobile devices equipped with context-aware technologies can be harnessed in facilitating CDM amongst agencies participating, and in addressing complex-problem situations such as terrorism.

2.3 TERRORISM

Terrorism is a constant threat to global peace and stability. The proliferation of terror attacks is attributed to globalization that has caused a collision of: cultures, political ideologies, religious fundamentalism and sub-sequent economic crises (Sawalha, 2017). A decade ago terrorism catastrophes were restricted only to certain isolated places however, this is no longer the case (Okoli, Iortyer, & others, 2014). The African continent is bearing the greatest brunt of this proliferation of terror attacks (Asongu & Nwachukwu, 2018). Poor governance, political instability and war in most parts of Africa has been blamed for creating an environment that enables and nurtures terrorism activities (Meierrieks & Gries, 2013).

2.3.1 Definition of Terrorism

Terrorism comes from the word “terror” which means intimidation of political opponents expressed in physical violence and destruction of property (Ozhegov, 1983). Terrorism has no universal definition (Schmid, 2011). Ahmed, Elgazzar and Hegazi (2005) refer to terrorism as an attack of unarmed civilians. Enders, and Sandler (2011) describe terrorism as “the premeditated use of threat or use of violence by individuals or sub-national groups to obtain a political agenda or social-objective through the intimidation of a large audience, beyond that of the immediate victim”. The United States Department of States defines terrorism as “politically motivated violence perpetrated against non-combat targets by sub-national groups usually intended to influence an audience” (US Department of State, 2003).

A review of the multiple definitions of terrorism highlights some common themes which include; mass destruction, the use of violence, the use of fear to intimidate individuals or governments, draw public attention and attack of unarmed civilians’ (Sawalha, 2017). Nonetheless, even though common themes and features have been identified, there is still no consensus on the definition of terrorism (Horgan, 2017) and hence the conclusion that terrorism is defined and understood differently amongst different practitioners (Sandler, 2015; Sawalha, 2017).

2.3.2 Domestic or Transnational Terrorism

Terrorism can either be domestic or transnational (Enders, Sandler, & Gaibullov, 2011). Domestic terrorism is home-grown in that the perpetrators and victims of the act of terrorism are members of the host country. Many acts of terrorism in developing countries can be attributed to domestic terrorism intended to extort

political concessions from a besieged government (Younas & Sandler, 2017). Transnational terrorism involves two or more countries. For instance, the victims and perpetrators of the terrorists attack in country A are citizens not only of country A but also of countries B, C, D etc. (Enders et al., 2011). Regardless of the form (transnational or domestic), terrorism is an extreme form of expression that is contrary to the values of modern democracy (Sawalha, 2017). Younas and Sandler (2017) have observed that the two forms of terrorism may have different implications. Enders, Sandler and Gaibullov (2011) have also indicated that domestic terrorism can in some cases translate in transnational terrorism and not the *vice versa* when domestic terrorists need more media attention or fame (Younas & Sandler, 2017).

2.3.3 Impacts of Terrorism

Although terrorism has attracted both multi and inter disciplinary investigations, its mitigation is still a challenge and can impact negatively on the economic growth of a targeted country (Keefer & Loayza, 2008; Sandler & Enders, 2008); at all levels “global, sub-national and national” (Abadie & Gardeazabal, 2003; Crain & Crain, 2006; Gaibullov & Sandler, 2011). In particular, terrorism activities affect investment, public spending, consumption and international flow of goods and capital (Abadie & Gardeazabal, 2008; Crain & Crain, 2006). In Africa, the situation is even worse since most African countries are still developing and are not able to absorb the adverse effects of terrorists’ attacks. This is because most African countries are still not well equipped resource wise and technically with the capacity to prevent or mitigate the terror attacks (Blomberg, Broussard, & Hess, 2011).

2.4 THEORETICAL UNDERPINNINGS OF THE STUDY

In order to meet the objectives of this study, two theories were adopted after reviewing literature on different theories under *systems thinking* and *decision making*.

2.4.1 Systems Thinking Theories

System thinking theories are used to analyze and understand the relationship between the different parts of a system and its objects in order to make better decisions. System thinking theories include: theory of synergetics, general systems theory, living systems theory, actor-system dynamics theory among others. In order to meet the current study’s objectives, the theory of synergetics under systems thinking has been adopted.

2.4.1.1 Theory of Synergetics

Synergetics is a cross-disciplinary theory that was founded by a physicist, Hermann Haken, in 1967 (Ochara & Odhiambo, 2018). Synergetics is derived from the Greek word *synergy* which means *working together*. For instance, if a system is composed of several parts, each of which performs a specific function, synergetics is the cooperation (working together) of the different parts of the system in carrying out a specific task (Cerra, Müller, & Reinartz, 2013).

The theory of synergetics measures, explains and describes the change and formation of patterns in complex (chaotic) systems based on the principles of self-organization (Tolstoy, Lesovik, Glagolev, & Krymova, 2018). Within synergetics, it is self-organization that identifies and explains the internal mechanisms and rules of complex systems which contributes to their sustainability (Qiao et al., 2017). In order for self-organization to take place, the system must be open in that, it allows the flow of internal and external variables through it (Liening, 2014; Liening, Geiger, Kriedel, & Wagner, 2016).

Self-organization is the process through which systems evolve their structure intrinsically without external intervention (Haken, 1984). It can also be the emergence of new structures (order) out of chaos (Prigogine & Stengers, 2018). Thus, synergetics is not only a theory of pattern formation, but a general theory of structures and model conceptualizations (Schiepek, Heinzl, Karch, Plöderl, & Strunk, 2016).

2.4.1.2 Concepts of the Theory of Synergetics

The concepts of the theory of synergetics include: macroscopic and microscopic levels, system elements, order parameters, control parameters, internal and external constraints and environment (see Figure 2-1). These are discussed below:

a) Microscopic and Macroscopic Levels

In a system, the microscopic level consists of the invisible reactions of system elements which lead to observations at the macroscopic levels (coherent behavior).

b) System Elements

System elements in synergetics are the ones responsible for forming new patterns, through self-organization, that are observable at macro-level.

c) Order Parameters

Order parameters within the theory of synergetics are the ones which inform and define how each part of a system abides by the rules of the game (Meynhardt,

Chandler, & Strathoff, 2016). In synergetics, the process of self-organization yields the emergence of coherent behavior of a system which is referred to as the order parameter. It is this order parameter that can be used to measure the efficiency of synergetics (Liening et al., 2016; Qiao et al., 2017).

d) Control Parameters

From a synergetics perspective, the control parameters have the capability of influencing the behaviour of the system elements at a macro-level. The control parameters can either be individual or group based. A slight distortion to the control parameter by the environment interferes with the overall coherent behavior of the system and eventually brings it to a stop, and instantly, the process of self-organization commences (Liening et al., 2016). The coherent behavior of a system is not determined by the control parameters but by varying the environment elements.

e) Environment

The surrounding area of a system is the environment. It is highly dynamical due to the continuous interaction between the various self-organizing systems and individual elements. This can result into an emergence of a new order parameter or macroscopic behavior of the system.

f) Constraints (Internal and External)

The internal and external constraints in synergetics have a regulative effect on the behaviour of system elements. The internal constraints are capable of influencing the functionality and interdependence of the system elements. It also sets the system's framework.

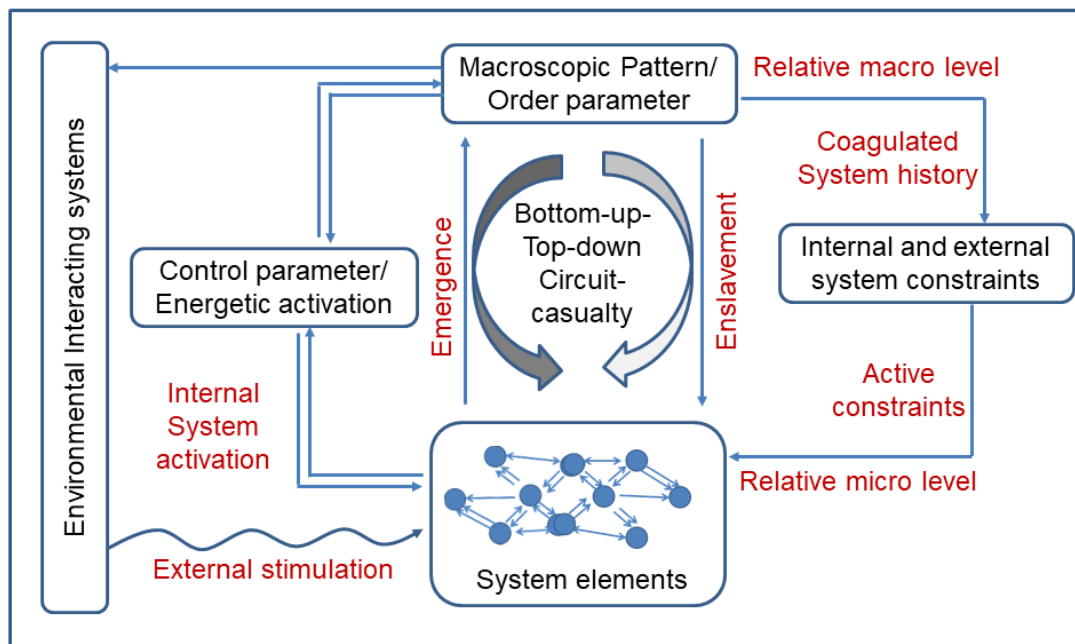


Figure 2-1: Key concepts of the theory of synergetics

2.4.1.3 Theory of Synergetics: In Practice

Traditionally, synergetics is mainly applied in the natural science domain (e.g. biology, physics and chemistry) however, its application has been extended to, and adopted in a variety of disciplines including: entrepreneurship, education, economics, social sciences and psychology amongst others (Schiepek et al., 2016). For instance, the theory has been employed successfully in sociology to model opinion and attitude change of large populations (Weidlich & Haag, 2012). This study adapts the theory of synergetics because:

- Theory of synergetics has been successful in understanding and explaining complex systems (Liening et al., 2016).
- By using order parameters within the theory of synergetics, one can observe and explain the sudden changes in a system that occur through self-organization (Schiepek et al., 2016).
- In synergetics, it is possible for one to observe and explain how the different individual part(s) of a system interact (Meynhardt et al., 2016; Schiepek et al., 2016).

The theory is applied in Chapter 4 of this thesis in structuring the terrorism problem in the digital age.

2.4.2 Decision Making Theories

Decision making theories can be used to understand the decision making processes adopted by different actors. The decision making theories include: rational choice theory, game theory, institutional theory, public choice theory amongst others. Institutional theory was adopted in this study because of its ability to investigate organizational behavior (Cai & Mehari, 2015).

2.4.2.1 Institutional Theory

Institutional theory has been applied in understanding and explaining organizational behavior (Cai & Mehari, 2015; Scott, 2013). Institutional theory suggest that the environment dictates the norms for appropriate organizational structure, operations, behavior and practices (DiMaggio & Powell, 1983; Meyer & Rowan, 1977). The evolution of institutional theory in various fields has been fueled by the need to understand organizations and their forms (Shehada, 2010). Initially, institutional theory was applied in political science, sociology and economics without emphasis on organizations and organizational forms. Its application in understanding organizations and their forms came much later (Shehada, 2010). As new questions such as *why do organizations tend to look alike?* (Bruton, Ahlstrom, & Li, 2010) came to the fore, a new concept (new-institutionalism) of institutional theory emerged (DiMaggio & Powell, 1983; Zucker, 1977).

The application of new institutionalism has been extended to different domains and has been referred to as:

- a) neo-institutional sociology theory;
- b) neo-institutional economic theory;
- c) neo-institutional theory; and
- d) neo-institutional political science theory.

New-institutionalism emphasizes more on schema and institutional logics, legitimacy, templates, field and institutional entrepreneurship (Greenwood, Oliver, Suddaby, & Sahlin-Andersson, 2008). Contrary, old-institutionalism focuses on informal structures, power and influence, coalitions and competing values (Greenwood, Hinings, & Whetten, 2014). Traditionally, institutionalism was more concerned with how different groups and organizations gained legitimacy by conforming to the rules and norms of the institutional environment (Bruton et al., 2010). However, old-institutionalism lacked the ability to explain variations and

change on how organizations responded to institutional influence (Hoffman, 1999; Scott, 2013). The evolution in application of institutional theory calls for a convergence of the old and new institutionalism (Greenwood & Hinings, 1996; Scott, 2013). Table 2-1 presents a summary of the differences between the old and new institutionalism.

Table 2-1: A comparison of the old and new institutionalism (adapted from Bukhari, 2014)

	Old	New
Conflicts of interest	Central	Peripheral
Source of inertia	Vested interests	Legitimacy imperative
Structural emphasis	Informal structure	Symbolic role of formal structure
Organization embedded in	Local community	Field, sector or society
Nature of embeddedness	Co-optation	Constitutive
Locus of institutionalization	Organization	Field or society
Organizational dynamics	Change	Persistence
Basics of critic of utilitarianism	Theory of interest	Theory of action
Evidence for critic of utilitarianism	Aggregation/Anticipated consequences	Unreflective activity
Key forms of cognition	Values, norms, attitudes	Classifications, routines, scripts, schema
Social Psychology	Socialization theory	Attribution theory
Cognitive basis or order	Commitment	Habit, practical action
Goals	Displaced	Ambiguous
Agenda	Policy relevance	Disciplinary

The old and new institutionalism differ in their objective: the new-institutionalism emphasizes on legitimacy as the main objective in an organization's survival (Meyer & Rowan, 1977), old-institutionalism emphasizes on political aspects in its analysis of group conflicts and organizational strategies (Powell & DiMaggio, 2012). For instance, as shown in Table 2-2 *conflict of interest* is a *core* factor in old-institutionalism but a *peripheral* factor in new institutionalism.

Despite the difference in perspectives between the old and new institutionalism, in this study both terms (old-institutionalism and new- institutionalism) are considered using the umbrella term "*institutional theory*". This is because of the justification explanation provided by (Bukhari, 2014, p.49):

“both the old and new approaches share skepticism toward rational-actor models of organizations, and each view institutionalization as a state dependent process that makes organizations less instrumentally rational by limiting the options they can pursue. In addition, both emphasize the relationship between organizations and their environment and further, both promise reveal aspects of reality that are inconsistent with organizations formal account. Each approach stresses the role of culture in shaping organizational reality.”

2.4.2.2 Concepts of Institutional Theory

The institutional theory comprises of the following key concepts, namely, institution, institutionalization and organizational field.

a) Institution

Institution has been defined in different ways due to its diversity and application (Mohr & Friedland, 2008). Scott (2013) describes an institution as “a multi-faced, durable, resilient social structure, made up of symbolic elements, social activities and material resources” (p.50). While Jepperson (1991) refers to an institution as “an organized, established procedure” (p.143). Further, Scott (1995) defines institution using three pillars, which include regulative (legal), normative (social) and cognitive (cultural):

- *Regulative pillar-* includes laws, regulations and associated sanctions. The pillar emphasizes that “it is a legal requirement to do things in a particular way otherwise sanctions may apply” (Ji, 2013, p.85). This pillar uses legal sanctioning as a basis for attaining legitimacy. Thus, to avoid suffering penalties due to non-compliance, organizations are forced to conform to rules (Hoffman, 1999).
- *Normative pillar-* emphasizes the normative rules. The pillar involves “the creation of expectations that introduce a prescriptive, evaluative and obligatory dimension into social life” (Scott, 2003, p.880). Normative systems include norms and values. Values specify what it is desirable while norms specify how things should be done (Scott, 2001). Under the normative pillar, legitimacy is embedded in societal beliefs and norms. Organizations comply with the normative rules out of moral or ethical obligation, or in accordance with the norms established by trade sectors, professional institutions and universities (Hoffman, 1999).

- *Cognitive-cultural pillar*- This pillar places emphasis on the existence of and the interaction between actors. The pillar refers to shared conceptions that make up social reality and the framework through which meaning is created (Scott, 2008). Symbols (e.g. words, signs, gestures) shape the meaning we attribute to objects and activities. Organizations normally abide by these rules of conceptions without conscious thought (Bukhari, 2014). Legitimacy is rooted in cultural orthodoxy.

According to Scott (1995), the three stated pillars are the *central* building blocks of institutional structure. These pillars constrain and empower social behavior through cohesive, normative and mimetic mechanisms (DiMaggio & Powell, 1983):

- *Coercive mechanisms*- are the external pressures arising from either the government or other powerful institutions that organizations are dependent on.
- *Normative mechanisms*- are pressures arising from professionalization. The forces which determine the way in which an organization operates based on the legitimate standards deemed appropriate in a particular field and context.
- *Mimetic mechanisms*- are mechanisms that induces an organization to imitate the structures, activities and systems of other organizations, arising in instances where there is no clear course of action (DiMaggio & Powell, 1983).

Table 2-2: A summary of the three pillars (adapted from DiMaggio and Powell, 1983)

	Regulative	Normative	Cultural
Basis for conformity	Obedience	Social obligation	Accepted as true
Basis of order	Regulative rules	Binding expectations	Constitutive schema
Mechanisms	Coercive	Normative	Mimetic
Logic	Instrumentality	Conformity	Orthodoxy
Indicators	Rules, laws and sanctions	Certification and credibility	Common beliefs Shared logics of action Isomorphism
Affect	Fear guilt/ innocence	Shame/honor	Certainty/confusion
Basis of legitimacy	Legally sanctioned	Morally governed	Comprehensible Recognizable Culturally supported

Further, for a comprehensive understanding of an institution, Scott (2001) in (p.48) provides a dense conception of the term institution that offers a broad view of institutions as follows:

- “Institutions are social structures that have attained a high degree of resilience.
- Institutions are composed of the cultural, normative and regulative elements, that together with associated activities and resources, provide stability and meaning to social life.
- Institutions are transmitted by various types of carriers including symbolic systems, relational systems, routines and artefacts.
- Institutions operate at multiple levels of jurisdiction, from the world system to localized interpersonal relationships.
- Institutions by definition connote stability but are subject to change process, both incremental and discontinuous”.

b) Institutionalization

Institutionalization is the process through which organizations become institutions (Fleck, 2007) and to institutionalize, is infusing with value beyond the technical requirements of tasks at hand (Selznick, 1957, p.17). Institutionalization reflects the distinctive history of organizations, the people and the groups involved the shared interests and the adaption to the environment (Selznick, 1957). It can also be something that happens to the organizations over time and varies from organization to organization (Scott, 2013). For instance, organizations with specific goals and technologically advanced are less subjected to institutionalization compared to those with vague goals and technologically challenged.

c) Organizational Field

The organizational field is a unit or level of analysis, which involves relational and symbolic dimensions that encompass all relevant actors, institutional logic and governance structures (Scott, 2008). It is constituted by a collection of “organizations that, in aggregate, constitute a recognized area of institutional life: key suppliers, consumer of resources and products, regulatory agencies and other organizations that produce similar products and services” (DiMaggio & Powell, 1983, p.143). Equally, Scott (2008) states that there is a high probability of organizational fields developing

around central disputes and issues. It is worth noting that organizational membership in the field can also be for a finite period of time, coinciding with an emergency and the growth and decline of the issue.

2.4.2.3 Critics of Institutional Theory

There are certain critics that have been directed towards institutional theory. These include:

- a) Mimetic pressures in institutional theory assume that over time organizations become similar. However, this is usually not the case. This is because organizations, as passive recipients of their operating environment, are always in constant change in their modes of operation (De Simone, 2017; Suddaby, 2010). This assumption of similarity gives the impression that institutional theory is all about stability and isomorphism while ignoring the fact that organizational change does exist (Scott, 2013).
- b) The overreliance of institutional theory on external factors while neglecting the internal factors in an organizational process has brought criticism to the theory (Chithambo, 2013).
- c) Institutional theory has also been criticized for its lack of explanatory power that can be used to explain the behavior of actors and their motivation; for instance what motivates them to adopt a technology (DiMaggio, 1988). This implies that institutional theory portrays organizations and the actors in the organization as passive recipients, who only make use of the readily available scripts from the governments, professionals to structure their actions (Falkner, Stephan, & Vogler, 2010).

Despite these criticisms directed at institutional theory, this theory still remains as the most appropriate theory for this study and was adopted because:

- a) Institutional theory provides useful guidelines for analyzing organizational issues such as organization-environment relationship emphasizing on the expectations, values, social rules and norms as source of pressure to the organization.

- b) Institutional theory provides a broad framework, including cultural elements to characterize and understand the difference reasoning of groups, organizations or societies.
- c) Unlike theories such as legitimacy theory, institutional theory focuses mainly on one aspect of an organization, for instance, how they attain legitimacy. Therefore, providing a richer and broader explanatory accounts (Ji, 2013). Hence, institutional theory gives room for multiple levels of institutional analysis, from broader political and economic contextual factors to the management perception of institutional pressures and internal decision making processes (Yang, 2014).
- d) Institutional theory assist the researcher to understand and explain the “irrationalities” in the context of organizations, which are also believed to drive the decisions made in the organizations (Avgerou, 2001).

The theory is applied in Chapter 5 of this thesis in investigating the factors influencing collaboration in decision making amongst counter-terrorism organizations.

2.5 CONCEPTUAL FRAMEWORK

Optimal/effective CDM is crucial and not an easy task to achieve in instances where multiple stakeholders/organizations are involved for instance in counter-terrorism. This can be attributed to the complex nature of the problem at hand which requires the involvement of stakeholders/organizations with varied skillset and expertise. Context-aware technologies are proposed in this study as one of the ways through which stakeholders can achieve optimal/effective CDM. Figure 2-3 presents the proposed conceptual framework for effective/optimal CDM amongst counter-terrorism organizations using context-aware technologies. Four components including; terrorism structuring, organizational characteristics/behaviour, context awareness and optimal/effective CDM are presented. Each part of the conceptual framework is described in detail as follows:

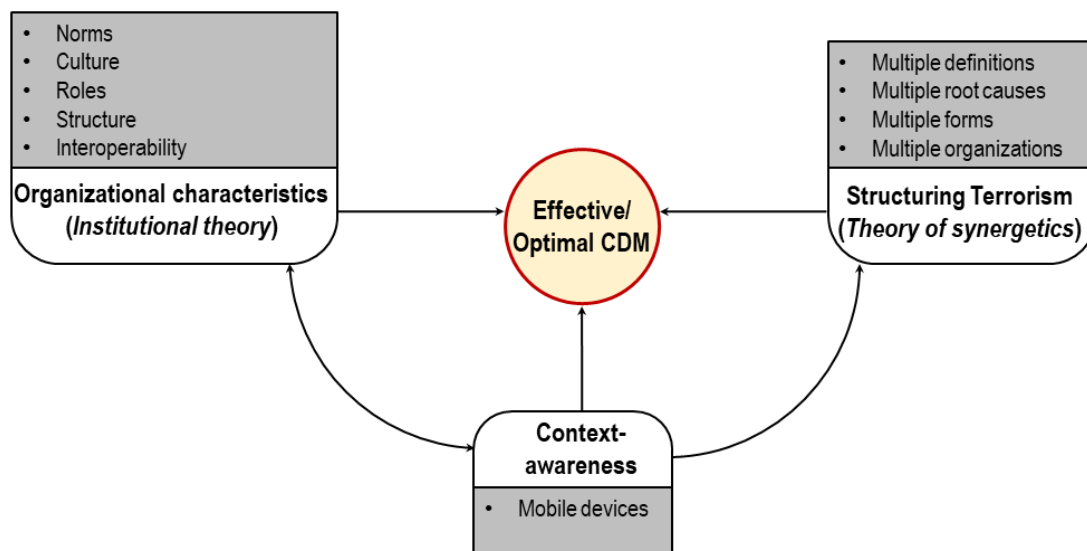


Figure 2-2: A conceptual framework for optimal/effective CDM

Organizational characteristics-Every organization regardless of its location (region, country or sector) has organizational characteristics that are peculiar to itself (Rus & Rusu, 2015). These characteristics entails the culture in the organization, leadership styles, beliefs, values, rules and regulations, norms, perceptions, structure etc. Smircich (1983) pinpoints that organizational culture for instance, is strong and consistent and often has an overwhelming influence of an organization and on the employees behaviour (p.21). The organizations/stakeholders involved in counter-terrorism comprises of private, public and non-governmental organizations (NGOs). The public wing consists of the police, the army, the intelligence etc. which abides by law and order and are loyal and very secretive at how they conduct their businesses

(Zhang et al., 2005). On the other hand, the NGOs practices are guided more with vision and goals which at times are at variance to those of the private and public sectors. The private sectors unlike the public sectors which are controlled predominantly by political forces are influenced by market forces (Khan & Khandaker, 2016). Nonetheless, for the achievement of an effective/optimal CDM amongst the counter-terrorism organizations/stakeholders, these organizational differences in terms of operandi of the private, public and NGOs needs to be taken into account and hence the use of institutional theory as an underpinning theory in this study in understanding the varied organizations characteristics/behaviour of counter-terrorism organizations/stakeholders.

Terrorism structuring - The lack of consensus on what really constitutes terrorism has made the implementation of counter-terrorism strategies by different organizations and governments quite challenging due to the constant evolution of terrorism and its dynamics (Campedelli, Cruickshank, & Carley, 2018). In addition, there is no one universally accepted definition of term terrorism. For instance, different organizations (i.e. UN, AU), countries, scholars, religions, communities have a different world view for the term and therefore describes it differently (Roberts, 2015). The terrorism menace is further compounded with uncertainties in the modus operandi of the terrorists, the multiple causal root causes, the different forms and types, the nature of terrorists and their associated activities, the several stakeholders/counter-terrorism organizations that are usually involved in the formulation and implementation of its counter-terrorism strategies (Kittiyankajon & Chetchotsak, 2018; Raghu et al., 2005). Thus to help understand the complex nature of the terrorism problem, theory of synergetics, a systems thinking theory, previously used in understanding complex problems was applied in this study to help with structuring the terrorism menace through understanding the different components.

Context-awareness - The capability of a device to provide the user with timely information based on the user's interest is referred to as context-awareness (Lee, 2007). Context-awareness empowers the device to identify and exploit a user's environment (context) and offer relevant information (Costa, Pires, van Sinderen, & Rios, 2004). It is this ability that can be exploited for collaborative purposes (Scoble, Israel, & Benioff, 2014). Data, sensors, location-based services, social media and mobile devices have been at the core of developments in context-awareness because

they are known influencers of decisions via context analysis and supported by a wide range of sensors, smart devices, and new evolutionary services.

Improvements in functionality of mobile devices, their portability as well as their low costs, has transformed mobile devices from devices for dialling numbers to personal assistants and this has led to increased integration of these devices in human lives (Lee & Salman, 2012). For effective/optimal CDM to be attained, it is important that the counter-terrorism organizations work together jointly synchronous/asynchronous through sharing information and by having the right information at the correct time. This can be easily achieved through the use of mobile collaborative applications such as e-calendar; text messages (SMS), e-mails etc. Synchronous/asynchronous capabilities are essential for mobile collaborative applications depending on the task to be carried out. Unlike synchronous collaboration tasks, minimal network availability is needed for asynchronous collaboration and hence it is easier to achieve mobile asynchronous collaboration compared to synchronous. The mobile devices are used in different kinds of situations, which make them a suitable platform for context-awareness.

Optimal/effective CDM - Optimal/effective CDM requires the counter-terrorism organizations to collectively work together in a group with a common goal of arrival at a universal solution that can be applied in terrorism mitigation, prevention or solution. In instances where multiple organizations are involved such as counter-terrorism, studies have shown that arrival at a universal solution is not an easy task (Keefe & Isenberg, 2013; Raghu et al., 2005). This can be attributed to the varied characteristics of the stakeholders/organizations involved in the decision making process.

2.6 RESEARCH GAP

The increased adoption of CDM practices between and among organizations is largely attributed to the complex nature of problems that organizations need to solve (Kapucu & Hu, 2016). Successful CDM practices are usually predicated upon by collective decision making, information and resource sharing and coordinated intervention (Office, 2014; Wu & Chang, 2018). Studies have shown successful CDM practices are essential in health care (Stiggelbout, Pieterse, & De Haes, 2015), emergency and disaster management (Kapucu & Garayev, 2011; Wu & Chang, 2018), supply chain (Neubert, Ouzrout, & Bouras, 2018), governance (Klievink, Bharosa, &

Tan, 2016) and construction (Oppl, 2017). Even though CDM practices have been successful in the above mentioned areas, CDM practices are often characterized by numerous management complexities (see Table 2-3) (Mikhaylov, Esteve, & Campion, 2018) and this has limited their applicability in some complex- problem situations such as terrorism and hence this study.

Context-awareness, one of key affordances of digital technologies, can be an effective medium that facilitates the successful practice and implementation of CDM practices between and among organizations (Kapucu & Haupt, 2016). This affordance, context-awareness, has been exploited so far in virtual teams (Gibbs, Eisenberg, Rozaidi, & Gryaznova, 2015), smart governance (Federici, Braccini, & Sæbø, 2015), knowledge sharing in distributed multinational organizations (Ellison, Gibbs, & Weber, 2015) and e-learning (Tarus, Niu, & Kalui, 2018) however, its application in CDM process has not been exploited especially in complex-problem situations such as terrorism in this study.

Table 2-3: Complexities associated with CDM practices

Factor	References
Mutual trust	(Bond-Barnard, Fletcher, & Steyn, 2018; McComb et al., 2017; Salam, 2017; Van Vuuren, Roberts-Lombard, & Van Tonder, 2012; Zaheer, McEvily, & Perrone, 1998)
Leadership	(Prichard & Moore, 2016; Regan, Laschinger, & Wong, 2016)
Communication	(Lancaster, 2019; Midgley et al., 2013)
Information sharing	(Drake, Steckler, & Koch, 2004; Gil-Garcia & Sayogo, 2016; Office, 2014)
Organizational culture	(Ivascu, Cirjaliu, & Draghici, 2016; Klimas, 2016)
Organizational structure	(Asal & Rethemeyer, 2008; Islam et al., 2015; Rivera, 2016)
Knowledge sharing	(Alsharo, Gregg, & Ramirez, 2017; Castro, Nagano, & Ribeiro, 2019; Razmerita, Kirchner, & Nielsen, 2016)
IT infrastructure	(Cai et al., 2016; Gil-Garcia & Sayogo, 2016; Lips, O'Neill, & Eppel, 2011)
IT inter-operability	(Casalino, 2014; Daclin, Chen, & Vallespir, 2016; Sayogo & Gil-Garcia, 2014)
Accountability	(Acar & Robertson, 2004; Romzek, LeRoux, & Blackmar, 2012; Spicer, 2017)

Relationships (Informal and formal)	(Kapucu & Demiroz, 2015; Sullivan & Skelcher, 2017)
Governance	(Alreshidi, Mourshed, & Rezgui, 2018; Emerson & Nabatchi, 2015; Howes et al., 2015)

2.7 SUMMARY

In this Chapter, a review of literature on the three main components in this study (CDM, context-awareness and terrorism) has been presented. A detailed view of the theories adopted in the study in understanding and solving the research problem is given. The research gaps are also identified. In the next Chapter, the research

methodology adopted is provided.

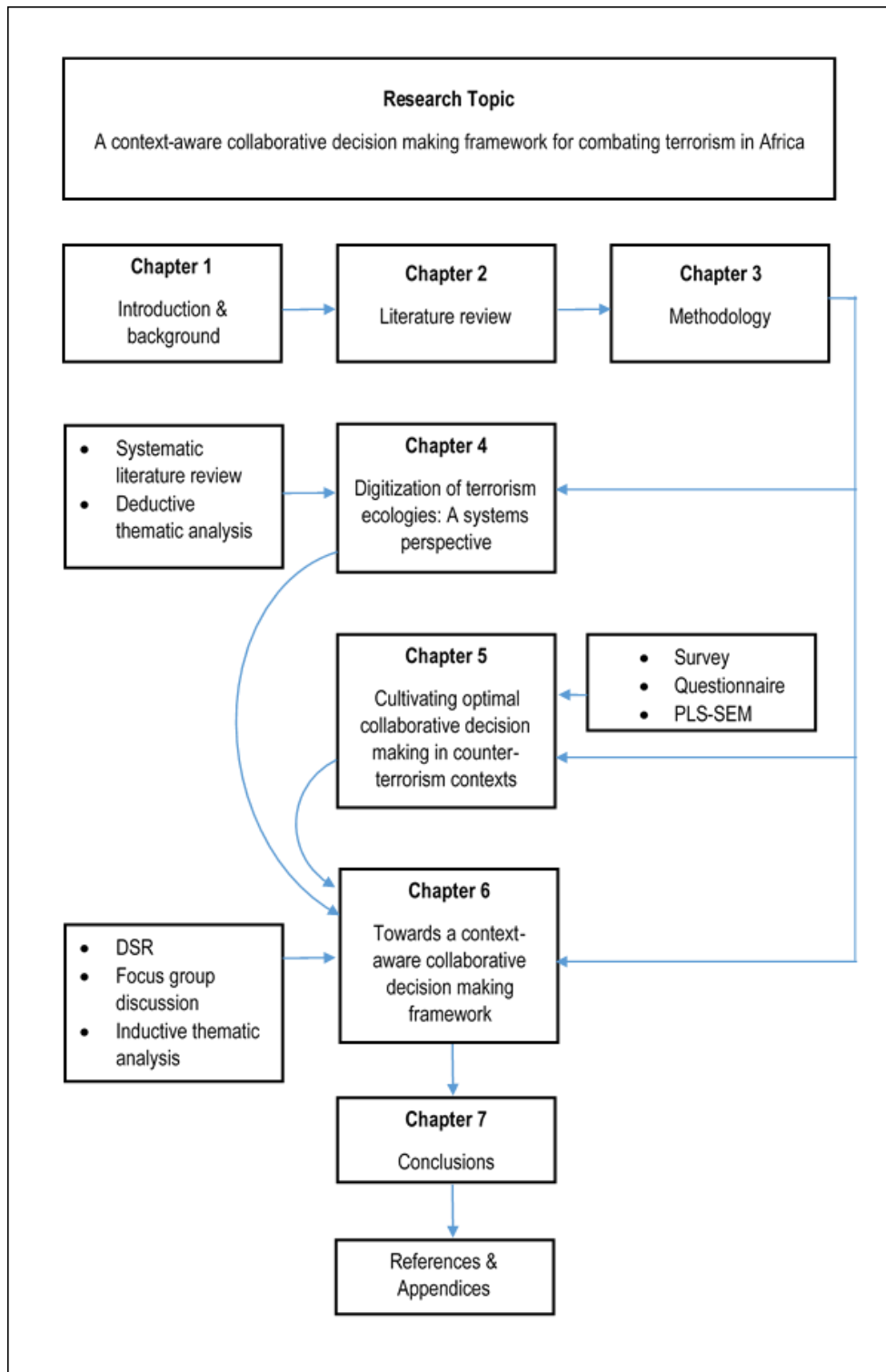


Figure 2-3: Thesis outline

illustrates the different Chapters discussed in this thesis and their relationships.

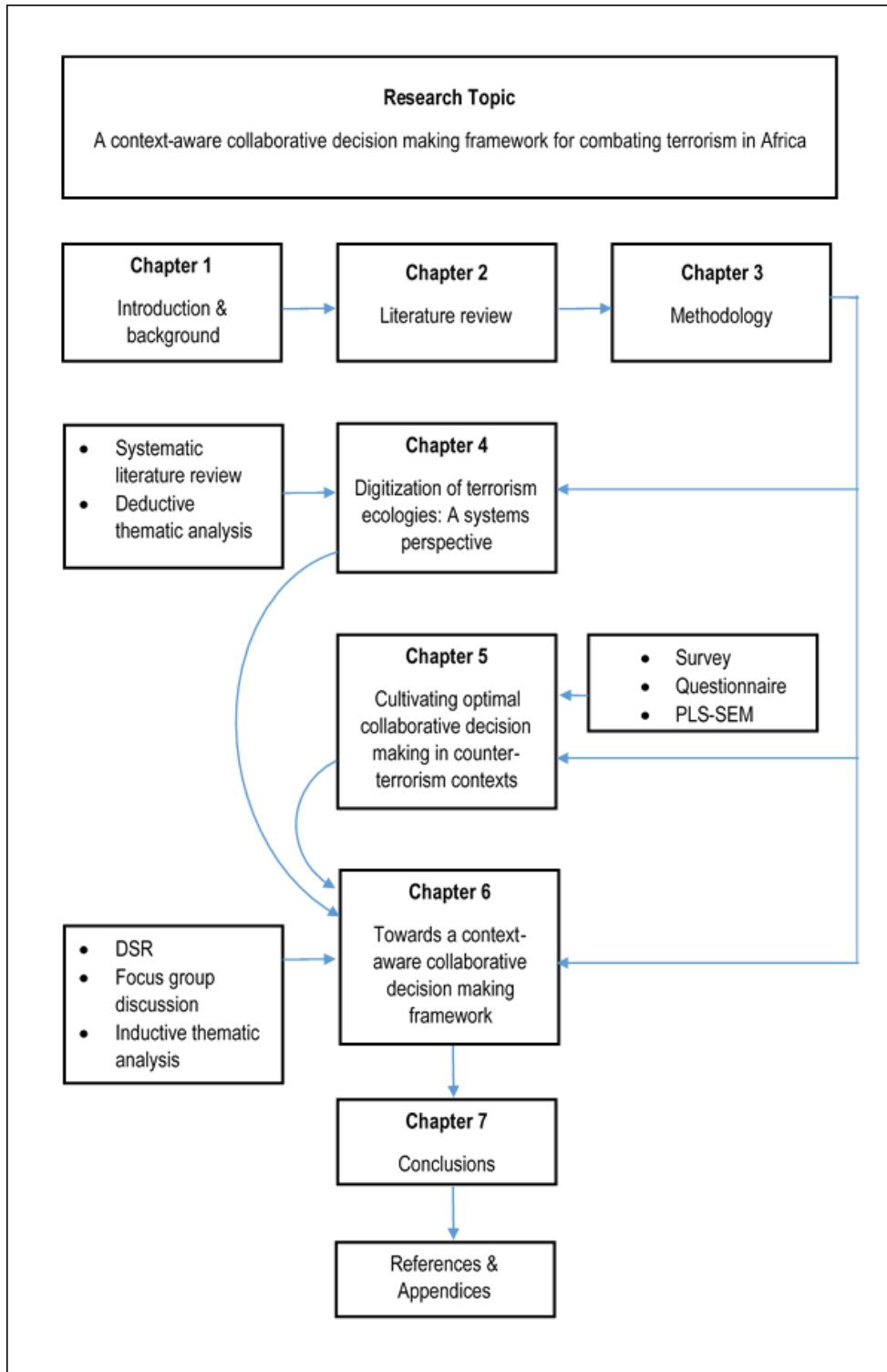


Figure 2-3: Thesis outline

Chapter 3: Research Methodology

This Chapter describes the research methodology adopted in the study and is structured as follows: In Section 3.1, an overview discussion of the research paradigms is provided, followed by a presentation of the different research approaches (Section 3.2). In Section 3.3, the different research strategies adopted in this study are presented. This is then followed by the data collection, data analysis, population and sample, reliability and validity and ethical considerations used in the study (Sections 3.4 - 3.7, respectively). The Chapter summary is given in Section 3.8.

3.1 OVERVIEW OF RESEARCH PARADIGMS

A research paradigm is a set of beliefs or underlying philosophical perspectives and assumptions that guides the actions and activities undertaken during the research process (Mingers, 2001). Research paradigms can be ontological, epistemological and axiological. For instance, the ontological perspective of Lewis and Ritchie (2003) consists of: critical realism, relativism, idealism and realism, while the epistemological perspective includes positivism and interpretivism. However, Saunders's (2011) and Guba et al.'s, (1994) epistemological perspectives consist of realism, positivism, pragmatism and interpretivism, which are based on ontology, epistemology and axiology.

Nevertheless, despite the lack of uniformity regarding ontology, epistemology and axiology, different research paradigms have been used in Information Systems (IS) research. The most popular epistemological differentiation common in IS is that of Orlikowski and Baroudi (1991). Orlikowski and Baroudi (1991) group the research paradigms under three categories, namely, positivism, interpretivism and critical realism. Their division follows the earlier categorization of Chua in (1986) and has

been acknowledged by various scholars within the IS community (Avison & Myers, 1995). Other research paradigms with applications in IS are pragmatism (Goles & Hirschheim, 2000) and the critical social theory (Ngwenyama & Lee, 1997) amongst others.

Table 3-1: Research paradigms in IS (adapted from Orlikowski and Baroudi, 1991)

	Positivism	Interpretive	Critical	Pragmatism
Ontology	<ul style="list-style-type: none"> ✓ Single, stable reality. ✓ Law like 	<ul style="list-style-type: none"> ✓ Multiple realities, ✓ Socially constructed 	<ul style="list-style-type: none"> ✓ Socially constructed reality, ✓ Power ✓ Discourse 	<ul style="list-style-type: none"> ✓ Singular and multiple realities (Researcher is external, multiple, and the view is that chosen to best answer the research questions)
Epistemology	<ul style="list-style-type: none"> ✓ Objective ✓ Detached observer 	<ul style="list-style-type: none"> ✓ Empathetic ✓ Observer subjectivity 	<ul style="list-style-type: none"> ✓ Suspicious ✓ Political ✓ Observer constructs versions 	<ul style="list-style-type: none"> ✓ Practicality (focus on practical application to problems by merging views to help interpret data
Axiology	<ul style="list-style-type: none"> ✓ Truth (Objective) ✓ Prediction 	<ul style="list-style-type: none"> ✓ Contextual understanding 	<ul style="list-style-type: none"> ✓ Contextual understanding ✓ Researchers values affect the study ✓ Inquiry is value bound 	<ul style="list-style-type: none"> Multiple stances (Researchers include biased and unbiased perspectives)
Method	<ul style="list-style-type: none"> ✓ Quantitative but can also be applied in qualitative 	<ul style="list-style-type: none"> ✓ Qualitative ✓ Interpretation ✓ Interactional 	<ul style="list-style-type: none"> ✓ The adopted method depends on the research matter (Deconstruction, textual analysis or Discourse analysis) 	<ul style="list-style-type: none"> ✓ Applies both qualitative and quantitative

Table 3-1 presents an overview of the commonly used research paradigms in IS and their philosophical perspectives. The next Section provides an in-depth explanation of pragmatism, which is the research paradigm adopted in the current study.

3.2 PRAGMATISM

Pragmatism is an outcome-oriented paradigm interested in determining meaning of things (Johnson, Onwuegbuzie, & Turner, 2007). It is commonly used within mixed method research (Biddle & Schafft, 2015). Teddlie and Tashakkori (2003) highlight that under pragmatism the research question is more important than the method adopted. The pragmatist approach draws heavily on inductive and deductive reasoning (Ihuah et al., 2013), and is also the best approach for answering the “what”, “why” and “how” research questions (Mark, Philip, & Adrian, 2009). Hence, the pragmatic approach was adopted in the current study.

3.2.1 Ontology

The essence of a pragmatist *ontology* is action and change; humans acting in a world which is in a constant state of becoming (Goldkuhl, 2012). Therefore, ontologically, this research supports the notion that reality is not constant and it is always changing and thus, a new reality can be created through introducing new artifacts. Thus, the objective in this study is the creation of an artifact (framework) that can be used in enhancing collaborative decision making in complex-problem situations such as terrorism using context-aware technologies.

3.2.2 Epistemology and Methodology

Epistemologically, pragmatism is grounded on the notion of ‘what works’ since research is usually viewed as multi-purpose (Wheeldon, 2015). Hence, pragmatism is good in addressing problems which cannot be fully addressed either qualitatively or quantitatively (Ihuah et al., 2013). In this study, in order to fully address the research objective, the epistemological view of a pragmatist is used and therefore *a mixed method* approach is adopted.

Table 3-2: Pragmatist overview

Ontological assumptions (<i>What is reality</i>)	Reality is constantly changing based on our actions
Epistemological assumptions (<i>How can I know reality</i>)	The best method is one that solves the problem. Finding out is the means and change is the main underlying aim
Methodology (<i>Process of research</i>)	Mixed methods approach

Table 3-2, gives an overview of the ontological, epistemological and methodological assumptions within the realm of pragmatism.

In this study, in order to fully address the phenomena of interest, the epistemological view of a pragmatist is used and therefore a mixed-method approach is adopted. This is because epistemologically, pragmatism is grounded on the notion of ‘what works’ (Wheeldon, 2015)

3.3 RESEARCH APPROACH

Research can be conducted qualitatively, quantitatively or using the mixed method approach.

Qualitative research is focused on identifying a diverse, holistic picture, fashioned with words, reporting comprehensive views of informants and conducted in a normal setting. Contrary, quantitative research is based on testing a theory composed of variables, measured with numbers and analyzed with numeral procedures in order to determine whether the prognostic generalization of the hypothesis holds true (Creswell, 2009). A mixed method approach employs both qualitative and quantitative research approaches. This can be in a single study or in a series of studies that aim to investigate the same underlying phenomena (Leech & Onwuegbuzie, 2009). Due to the nature of the problem under investigation in this study, a mixed method approach is adopted.

3.4 RESEARCH STRATEGY

Research strategy is the technique(s) adopted in carrying out a study (Kothari (2004). It is usually influenced by three factors: the topic under investigation; the research question; and the research objective. It is these factors that in turn influences the data collection techniques used in a study (Ihuah et al., 2013). Table 3-3 and Table 3-4 provide the different research strategies that a researcher can adopt in a study based on the nature of research (qualitative or quantitative). Likewise, a combination of more than one strategy can also be used in a study and, this can be achieved either through triangulation, where one research strategy is used to confirm or develop a holistic outcome of another strategy, or through mixed methods, where both the qualitative and quantitative research strategies are used in resolving the research problem (Creswell, 2013).

In this study, both qualitative and quantitative research strategies are employed. A discussion of the chosen strategies is presented in the next sub-Sections (sub-Section 3.4.1, 3.4.2 and 3.4.3 respectively).

Table 3-3: Qualitative research strategies (adapted from Kiptoo, 2017)

Research Strategy	Description of the research strategy
Appreciative inquiry	Researcher acts as facilitator with technique that can be used to improve a wider range of contexts. Discovery – an “ <i>appreciation</i> ” of what already exists Design - Formulate vision and strategy Delivery – Implementation plan
Design science research	Involves the analysis of the use of and performance of designed artifacts in order to comprehend, explain and improve the behavior of aspects of IS.
Action research	Involves determining current situation of interest and then designing an intervention. Contributes both to research and practice.
Case study	Explores a single entity or phenomena bounded by time and activity. Collects detailed information using a variety of data collection methods over a sustained period of time.
Focus group	Stimulates thinking and creativity through the dynamics of interaction in the context of a small group.
Ethnography and participant observation	Involves the research studying an intact group of individuals in their natural setting over a period of time. Observing what they are doing as well as what they say they are doing.
Grounded theory	Seeks to develop theory that is grounded in data, systematically gathered and analyzed. Rigorous and a detailed method.
Hermeneutics	Theory of interpreting meaning. Primarily concerned with text and text dialogue
Semiotics	Study of signs. By nature inherently interpretive.
Narrative inquiry	Entails documentation and analysis of individual stories and personal accounts.

Table 3-4: Quantitative research strategies (adapted from Kiptoo, 2017)

Research strategy	Description of the research strategy
Surveys	Involves acquiring information about one or more groups of people by asking them questions and tabulating their ideas with the goal of learning about a large population through a sample of the population.
Observational studies	Focus on a particular aspect of behavior that is quantified in some way either by counting each occurrence of the behavior or by rating the behavior for intensity, accuracy, maturity etc.
Developmental designs	Study how a particular characteristic/attribute in individuals changes with time. The methods used in studying such a characteristic can either be through longitudinal study or cross-Sectional study. In a <i>cross-Sectional study</i> , a group of people with different age groups are sampled for comparison purposes. Whereas in a <i>longitudinal study</i> , a single group of people are followed over time and data collected at particular time over a period (Mathers et al., 2007)
Correlational research	Examines the extent to which the difference in one characteristic relates to the difference in one or more other characteristics (Leedy & Ormrod, 2001) .

3.4.1 Design Science Research

Design Science Research (DSR) is a research strategy within the pragmatist worldview. Its purpose is to modify existing situations into preferred situations (Simon, 1996). DSR has been used as a research paradigm, a research approach and a research methodology for the design of an artifact (Gregor & Jones, 2007). An artifact in DSR can either be a model, a framework, an algorithm, a construct or a method among others (Kuechler & Vaishnavi, 2008; Offermann, Blom, Schönherr, & Bub, 2010; Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007; Winter, 2008). DSR is often viewed as Design Research (DR). However, according to Kuechler and Vaishnavi (2008), DR and DSR are very different. DR emphasizes more on design while DSR focuses mainly on the use of design as a research technique or method. In this study, DSR is used as a research technique/strategy since it supports the creation of artifacts to solve real-world problems.

The adoption of DSR in IS resulted from the need to incorporate system development into the research process, using a multi-methodological approach that brings together experiments, building of theory, systems development and observations (Nunamaker & Chen, 1990). This provided the basis for DSR adoption in IS research with Hevner, March, Park and Ram (2004) developing a framework for carrying out DSR (see Figure 3-1) as well as guidelines for carrying out DSR (see Table 3-5).

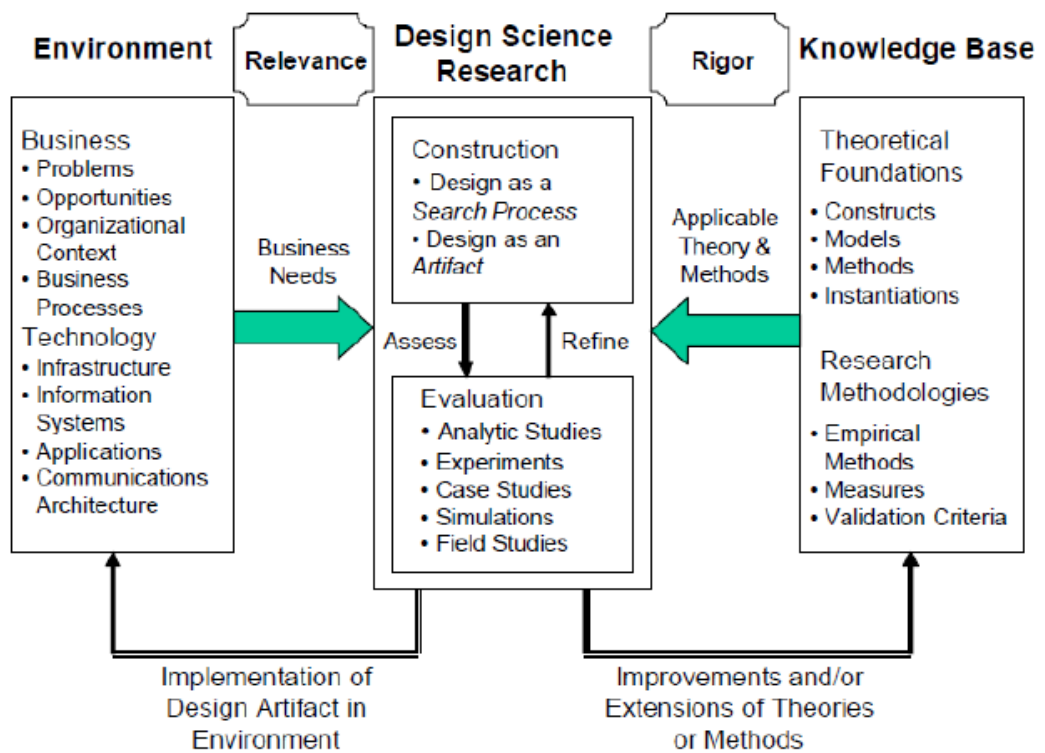


Figure 3-1: DSR framework (source: Hevner et al., 2004)

Table 3-5: Guidelines for DSR (adapted from Hevner et al., 2004)

Guideline	Description
#1.Design as an artifact	In any DSR, an artifact which is identifiable and viable must be produced.
#2.Problem relevance	The objective of any DSR is to develop technology-based solutions to important and relevant business problems.
#3.Design evaluation	The quality, efficacy and utility of the design artifact must be evaluated in a rigorous manner.
#4.Research contribution	DSR contribution which can take the form of design artifact, new foundations (e.g. models, constructs, methods) and /or new (evaluation) methodologies needs to be very clear and verifiable.
#5. Research rigor	DSR must apply rigorous methods in the development and evaluation of the artifact.

#6.Design as a search process	An effective artifact requires the use of means to reach the desired ends whilst satisfying laws in the problem environment.
#7.Research communication	DSR results should be presented in an effective way meeting both the rigor and the relevance requirements of the academic audience and professional audience (e.g. managers) respectively.

In summary, the DSR guidelines proposed by Hevner et al., (2004) as shown in Table 3-5, emphasizes on four aspects:

- i. The rigorous development of an artifact.
- ii. The developed artifact should meet quality standards.
- iii. DSR should contribute to body of knowledge.
- iv. The developed artifact has to be evaluated (Naidoo, Gerber, & van der Merwe, 2012).

3.4.2 DSR Processes

The lack of consensus on what constitutes a DSR process has led to different connotations and steps in carrying out DSR (March & Smith, 1995; Nunamaker & Chen, 1990; Peffers et al., 2007; Takeda, Veerkamp, & Yoshikawa, 1990; Vaishnavi & Kuechler, 2004). Table 3-6 gives a summary of the different DSR processes that have been proposed by the various scholars. The DSR process followed in this study is presented in more detail in the sub-sequent Section.

Table 3-6: The various DSR processes (adapted from Offermann et al., 2010)

	(Peffers et al., 2007)	(Takeda et al., 1990)	(Nunamaker Jr & Chen, 1990)	(March & Smith, 1995)	(Vaishnavi & Kuechler, 2004)	(Offermann, Levina, Schönherr, & Bub, 2009)
Step1	Problem identification and motivation	Enumeration of the problem	Construct a conceptual framework.	Build	Awareness of the problem	Problem identification

Step2	Define the objective of the a solution	Suggestion	Develop a system Architecture	Evaluate	Suggestion	Solution design
Step3	Design and development	Development	Analyze and design a system		Development	Evaluation
Step4	Demonstration	Evaluation to confirm the solution	Build the system		Evaluation	
Step5	Evaluation	Decision on a solution to be adopted	Observe and evaluate the system		Conclusion	
Step6	Communication					

3.4.2.1 DSR Process according to Peffer's et al., (2007)

As indicated in Table 3-6, various DSR processes has been suggested by different DSR pioneers. However, for the purposes of this study, Peffer's et al., (2007) sequential process of conducting DSR process seems most appropriate. In creating the DSR process, Peffer's et al., (2007) considered three objectives:

- (1) To provide a nominal process for conducting DSR.
- (2) To build upon prior literature about DSR in IS.
- (3) To provide researchers a model or template to structure the research output.

These objectives were realized in the six steps presented below.

Step 1: Motivation and Identification of the Problem - This step anchors on the proper (clear) definition of the problem as well as its solution (the artifact). Proper conceptualization of the problem is crucial as it gives the justification as to why the problem solution is needed.

Step 2: Define Objectives to a Solution - This step involves the formulation of the research objectives based on the problem under investigation as well as the identification of feasible and unfeasible solutions. The objectives can either be qualitative or quantitative: where qualitative provides the justification why the new artifact supports problem solution, quantitative justifies the need for the new artifact

over the old ones. The resources required in this step include: knowledge, current solutions (if available) and their efficacy.

Step 3: Design and Development -This step entails the building of the artifact - the solution to the problem under investigation.

Step 4: Demonstration - In this step, the developed artifact (*in step 3*) is tested with the aim of finding its suitability in solving the envisaged problem. It involves either using the artifact in a case study, experimentation, simulation, proof, among other areas. The resource required in this step is a strong background of knowledge on how the developed artifact can be used in problem solution.

Step 5: Evaluation - The evaluation process involves determining whether the proposed solution addresses or fails to address the defined problem in *step 1*. It involves comparing the actual results obtained from using the developed artifact in *step 3* to the objective of the solution. Based on the evaluation results, Peffers et al., (2007) proposes that a decision be made as to whether the DSR process progresses to step 6 or reverts back to step 3.

Step 6: Communication-This is the final step of the DSR process. It involves communicating the findings from the study to relevant audience such as practicing professionals. This can be done through research publications, both scholarly and professionally.

Importantly, despite the execution of the DSR process in a sequential manner, it does not mean that researchers must follow the process in the stated order (*from step 1-to-6*). Peffer's et al., (2007) explain that based on a study's research problem, the DSR process can start from any step and move outward.

In DSR process, different approaches can be adopted in problem solution. The approaches include: a problem-centered approach, a client-context initiated solution approach, a design and development centered approach and an objective-centered solution approach.

Problem-Centered Approach- This approach is adopted in instances where there is prior knowledge of the research problem based on previous observations and suggestions. This approach requires the sequential following of the outlined steps (*from step 1-to-6*), which is the case in this study.

Client-Context Initiated Solution- The execution of the client-context initiated solution approach normally starts from *step 4* and is based on the observation of a practical solution that worked. It could be the byproduct of a consulting experience and requires researchers to work backwards and to apply rigor to the process retroactively.

Design and Development Centered Approach- This approach commences with *step 3* and involves applying an existing artifact in a different domain where nobody has ever thought that it could be applied in solving a problem. The artifact may have been used somewhere else to solve a different problem, or it may have seemed as an analogical idea.

Objective-Centered Solution - This type of approach has some possibility of being triggered by an industry or a research problem that can be resolved with the development of an artifact.

Figure 3-2 presents the DSR process proposed by Peffer's et al., (2007) and each of the different research approaches a researcher can adopt in a study.

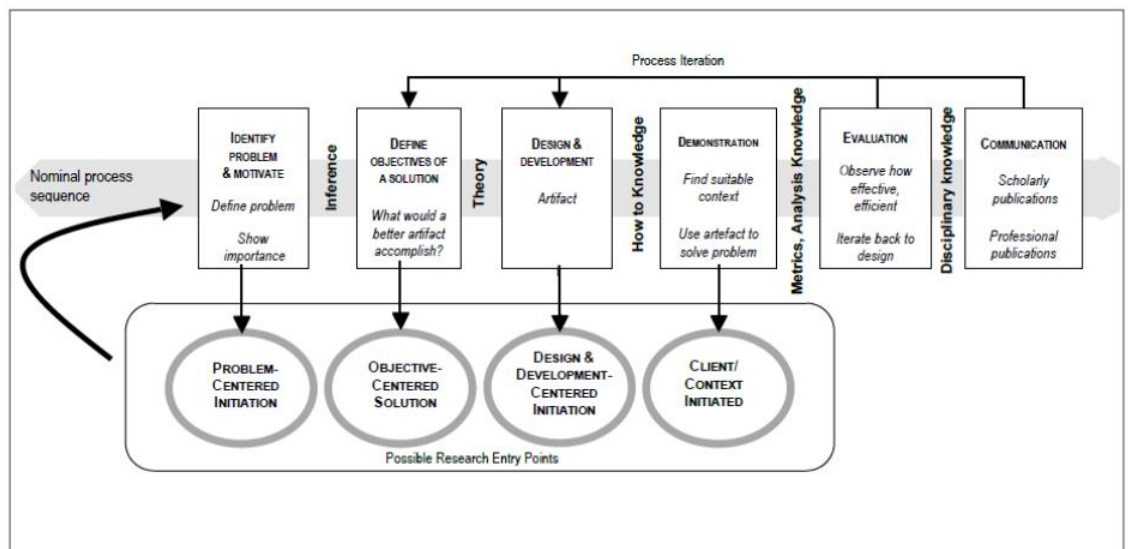


Figure 3-2: Peffer's DSR process (source: Peffers et al., 2007)

3.4.2.2 Implementation of DSR Process in this Study

The DSR process in this study was guided by the problem-centered approach as outlined in Table 3-7. The study aimed at enhancing Collaborative Decision Making (CDM) amongst counter-terrorism organizations through the use of context-aware technologies. The study is dependent on prior knowledge of poor CDM in complex-

problem situations resulting from poor co-ordination and information sharing. DSR is adopted in this study since it supports creation of artifacts to solve real-world problems. In this study, the goal was to create a framework (an artifact) that can be used to solve CDM in terrorism related instances.

Table 3-7: DSR process according to Peffers et al., (2007)

DSR process activities	Description of each of the DSR process activities	In relation to the study
#Problem identification and motivation	<i>What is the problem?</i> Identify the problem and justify why its solution is important.	The lack of collaboration, poor information sharing, institutional rivalry, lack of co-operation and lack of coordination was evident during the terror attacks in Africa (i.e. Westgate mall attack, Garissa University and DusitD2 attacks in Kenya) hence, the need for developing a framework that can be used in enhancing CDM amongst counter-terrorism organizations.
#Define objectives of the solution	<i>How can the problem be solved?</i> Define the goal of the research.	<ul style="list-style-type: none"> ✓ Literature review (<i>sub-question 1,2,3; Chapter 2</i>) ✓ Structuring of the terrorism problem in the digital age (<i>sub-question 1;Chapter 4</i>) ✓ Identification of the factors influencing collaboration in decision making amongst counter-terrorism organizations (<i>sub-question 2;Chapter 5</i>)
#Design and development	Create the artifact (framework).	Framework development (<i>sub-question 1,2,3; Chapter 6</i>)

#Demonstration	<i>Demonstrate the use of the artifact.</i>	Use of focus group interviews
#Evaluation	<i>How well does the artifact work?</i>	Use focus group interviews to determine the credibility of the development framework.
#Communication	Communicate the problem solution	Peer reviewed publications, conference presentations and PhD thesis.

3.4.3 Surveys

Surveys are particularly useful for non-experimental descriptive research design that seek to describe reality (Mathers et al., 2007). Surveys in most instances are restricted to a representative sample of the potential group that the research is interested in, for reasons of practicality and cost effectiveness. The common forms of surveys include:

- ***Cross-sectional surveys*** - A form of survey conducted just at a point in time. Cross-Sectional surveys provide the researcher with a snapshot of what is happening in his/her group of interest at a particular time. Cross-sectional survey takes a descriptive or exploratory form that simply sets out to describe behaviors or attitudes.
- ***Longitudinal surveys*** - Unlike cross-section surveys, longitudinal surveys occur over time and can either take the form of cohort surveys or trend surveys.
 - *Cohort surveys* - This is a form of longitudinal survey that involves following the same group of people over time.
 - *Trend surveys* - This is a form of longitudinal survey that involves following different set of people over time, taking repeated sample while using the same set of questions.
- ***Exploratory or correlational surveys*** - These surveys involve using survey data to try explore causal relationships between two or more variables.

Some of the reasons for using surveys in a study according to Mathers et al. (2007) are:

- ***Efficiency*** - Surveys are efficient in recruiting participants. This is because they can use random sampling techniques to choose a small sample size that

can be used to infer the interest of the bigger populations in terms of what they think, do or want.

- **Covering geographically spread samples** - Surveys use various techniques to collect data such as postal questionnaires, telephone interviews and online surveys. Thus, by using surveys, widely dispersed participants can be accessed and included in a research study.
- **Flexibility** - Surveys can easily be combined with other techniques to provided richer data. For instance, combining surveys with interviews etc.

Despite the stated advantages, surveys pose some limitations; for instance, surveys unlike focus groups are not considered effective for explaining the “*why*” questions such as “why people think or act the way they do”. Similarly, the representativeness of a survey is entirely dependent upon the accuracy of the sampling frame used and in certain instances it is difficult to identify an accurate or up-to-date sampling frame.

Surveys are commonly used in describing and exploring human behavior (Singleton, Straits, & Straits, 1993). Thus, in order to find answers to the second sub-question in this study, “*what are the key factors influencing collaboration in decision making amongst stakeholders involved in counter-terrorism?*”, cross-sectional surveys were used. Table 3-8, gives the constructs and their respective indicators used in the survey that were developed based on the guidelines of institutional theory (see section 2.4.2.1).

Table 3-8: Constructs and indicators used during the survey process

CONSTRUCTS	INDICATORS
Information sharing (Lips, O’Neill, & Eppel, 2011; Pardo, Gil-Garcia, & Luna-Reyes, 2010; Praditya, Dhata; Janssen, 2015; Wu, Chuang, & Hsu, 2014)	Information sharing policy (Dawes, 1996; Gil-Garcia, Pardo, & Burke, 2010; Landsbergen & Wolken, 1998; Yih-Tong Sun & Scott, 2005)
	Peoples power (number of representatives) (Olson, Balmer, & Mejicano, 2011; Purdy, 2012)
	Accountability (Acar & Robertson, 2004; Berg, 2009; Forrer, Kee, Newcomer, & Boyer, 2010; Janssen, 2007; B. G. Peters, 1998; Romzek et al., 2012)
Organizational perspectives (Gil-Garcia, 2012; Pardo, Gil-Garcia, & Burke, 2008b; Rivera, 2016)	Institutional bureaucracy/hierarchy (Egeberg, 2007; Fountain, 2004; Nooshinfard & Nemati-Anaraki, 2014; O’Leary & Vij, 2012; Pardo et al., 2010; Rowley, 2011; Yang & Maxwell, 2011)

	Roles and responsibilities (Job specificity) (Bryson, Crosby, & Stone, 2006; Gil-García & Pardo, 2005; Sayogo & Gil-Garcia, 2014; Yih-Tong Sun & Scott, 2005)
	Norms and regulations (Bryson et al., 2006; Egeberg, 2007; Sayogo & Gil-Garcia, 2014)
Relationships (Cross & Prusak, 2002; Hardy, Phillips, & Lawrence, 2003; McNeish & Mann, 2010; Menger, Stallones, Cross, Henry, & Chen, 2015)	Communication frequency (communication flow) (Corteville & Sun, 2009; Green, Rockhill, & Burrus, 2008; Haycock, 2007; Montiel-Overall, 2008)
	Mutual Trust (N. Chen & Chen, 2010; Hassan et al., 2012; Martins et al., 2017; McNeish & Mann, 2010; Savoldelli, Codagnone, & Misuraca, 2014; Wu et al., 2014; Yang & Maxwell, 2011)
	Informal relationships (Ingram & Roberts, 2000; Madlberger, 2011; Menger et al., 2015; Perrault, McClelland, Austin, & Sieppert, 2011; Pina-Stranger & Lazega, 2011)
	Communication (open communication, no communication tension or communication problem) (Crowther, 2014; Desourdis & Contestabile, 2011; Gilja, 2013; Montiel-Overall, 2008; Olson et al., 2011)

Table 3-8 Continued

CONSTRUCTS	INDICATORS
Co-operation (Hassan et al., 2012; Kim, Park, Ryoo, & Park, 2010; Lee, Stajkovic, & Cho, 2011)	Participation (personal participation and departmental participation in decision making) (Einbinder, Robertson, Garcia, Vuckovic, & Patti, 2000; Hardy et al., 2003)
	Conflict resolution (Dietrich, Eskerod, Dalcher, & Sandhwalia, 2010; Foster-Fishman, Berkowitz, Lounsbury, Jacobson, & Allen, 2001; Jordan & Troth, 2004)
	Leadership (Crosby & Bryson, 2010; Eglene, Dawes, & Schneider, 2007; Huxham & Vangen, 2000; Morse, 2010; Müller-Seitz, 2012)
Technical (Gil-Garcia & Sayogo, 2016; Praditya, Dhata; Janssen, 2015)	Infrastructure (Technical infrastructure) (Gil-Garcia & Sayogo, 2016; Lips et al., 2011; Pardo et al., 2010; Qaisar & Khan, 2010)
	Technical (IT) capability (Skilled personnel) (Einbinder et al., 2000; Gil-Garcia, 2012; Gil-Garcia & Sayogo, 2016; Lips et al., 2011; Yang & Maxwell, 2011; Yang & Wu, 2014)
	Technical (IT) interoperability (Incompatibility of the hardware and software; Inconsistent data structures) (Casalino, 2014; Gil-Garcia, 2012;

	Lips et al., 2011; Sayogo & Gil-Garcia, 2014; Steinfield, Markus, & Wigand, 2011)
Effectiveness and Efficiency (Eisenhardt, Furr, & Bingham, 2010)	Organizational transparency (Chun, Shulman, Sandoval, & Hovy, 2010; Gil-Garcia, Chun, & Janssen, 2009; Pasquier & Villeneuve, 2007; Steinfield et al., 2011)
	Commitment (Hardy et al., 2003; Martins et al., 2017; Sayogo & Gil-Garcia, 2014; Wu et al., 2014)
	Flexibility (Eisenhardt et al., 2010; Olson et al., 2011; Popp, MacKean, Casebeer, Milward, & Lindstrom, 2014)

3.4.4 Systematic Literature Review

A Systematic Literature Review (SLR) involves collecting, analyzing and interpreting data collected from secondary sources (Kitchenham, 2004). The three key activities undertaken in any SLR involves the following: identification and description of previously published relevant research; a critical appraisal of the research method; and the bringing together of aggregated findings into a synthesis of research findings. The five steps of the SLR in this study were adopted from (ten Ham-Baloyi & Jordan, 2016) and are discussed below.

- Step 1: **Review question**- The question(s) that guide the SLR process needs to be answerable and searchable and therefore while constructing such a question(s) aspects such as the population of interest, outcome of interest, intervention and comparative intervention need to be considered.
- Step 2: **Literature search**- This involves developing a strategy to help with the identification of what is to be included and excluded in relation to the research question while searching the literature. Language should not be a barrier and if needed, interpreters should be involved.
- Step 3: **Critical appraisal**- This involves an in-depth appraisal of the selected studies, so that reported research not meeting the inclusion criteria, including the strength of the evidence, can be excluded from the final sample (Centre for Evidence-Based Conservation, 2009).
- Step 4: **Data extraction**- Centre for Reviews and Dissemination (2009) refers to data extraction as “the process by which researchers obtain the necessary information about study findings from the included

studies”(p.28). In this step, the relevant findings that meet the selection criteria are combined together as evidence concerning the question posed.

- Step 5: **Data synthesis**: This is the final step of the review process and it involves summarizing all the studies that have met the inclusion criteria to form an outcome of the systematic review (Centre for Reviews and Dissemination 2009; Kitchenham 2004).

In this study, SLR procedure was used to guide in answering the sub-research question, how can the terrorism problem be structured in the digital age? SLR was used in the study since it is a good technique that provides complete and exhaustive literature in relation to the problem under investigation.

3.5 DATA COLLECTION

There are several techniques that can be used in data collection (Creswell, 2013). The data collected can either be quantitative or qualitative (Olivier, 1997) and based on the source, it can either be primary or secondary. *Primary data* is data in its raw form (unpublished data sources) and can be gathered directly from the respondents while, *secondary data* is data that has already been collected and analyzed by someone and can either be published or unpublished (Creswell, 2013; Klein & Myers, 1999).

In this study, both primary and secondary data sources were used. Table 3-9 gives the respective data collections techniques adopted for each sub-question followed by a discussion of the respective data collection techniques.

Table 3-9: Data collection techniques used in this study

Sub-Question	Data Collection Method Used
Sub-Question 1 (<i>How can the terrorism problem be structured in the digital age?</i>)	Systematic literature reviews (elaborated in section 3.4.4)
Sub-Question 2 (<i>What are the key factors influencing collaboration in decision making amongst stakeholders involved with counter-terrorism?</i>)	Structured-questionnaires
Sub-Question 3 (<i>How can context-aware technologies be used in enhancing CDM amongst stakeholders involved in counter-terrorism?</i>)	Focus group interviews

3.5.1 Questionnaires

Annum (2017) refers to questionnaires “as a systematically prepared form or document with a set of questions designed to elicit response from respondents’ for the purposes of collecting data or information” (p.1). The quality and credibility of the collected data using questionnaires is dependent on:

- The mode in which the questionnaire is administered and formulated.
- The way in which the questionnaire is delivered to the respondents.
- The method used to contact respondents for information retrieval.

However, it should be noted that in a questionnaire, the respondent has a choice to either respond or not respond to the questionnaire.

Questionnaires can either be structured or unstructured:

- **Structured questionnaires or closed ended** - Is a form of questionnaire where the choices made by the respondent are limited to a set of options provided in the questionnaire.
- **Unstructured questionnaires or the open ended form** - A form of questionnaire where the respondent is given a chance to express his/her opinions using his/her own words.

In this study, *a structured / closed ended questionnaire* was used for the following reasons:

- They are easy to answer and thus, obtaining data is easy. This is because respondents require less time to choose from a set of options that best applies to them.
- It is much easier to reach large sample which can be representative to the whole population.
- It is easier to check for reliability. This is because the questions are standardized and all the respondents are asked similar questions.

3.5.2 Focus Group Interview

A focus group interview is a form of a qualitative data collection technique. Focus group interviews have been used in various contexts in terms of the research topic, the participants, the manner in which they are organized and the purpose (teaching and research) (McLafferty, 2004).

Focus groups are a better option in situations where the interest is in finding information concerning peoples' perceptions; for instance, how they feel or think about a particular topic. Therefore, this study used focus groups in order to answer the third sub-research question of this study, *how can context-aware technologies be used in enhancing CDM amongst stakeholders involved in counter-terrorism?*

3.6 DATA ANALYSIS

Data analysis can be done using different techniques (Creswell, 2013). Since each sub-question in this study had its own data collection technique, difference data analysis techniques as seen in Table 3-10 were employed.

Table 3-10: Data analysis techniques used

Sub-Question	Data analysis technique
Sub-Question 1 (<i>How can the terrorism problem be structured in the digital age?</i>)	Thematic Analysis (TA) and Soft Systems Methodology (SSM)
Sub-Question 2 (<i>What are the key factors influencing collaboration in decision making amongst stakeholders involved in counter-terrorism?</i>)	Partial Least Squares Structural Equation Modelling (PLS-SEM)
Sub-Question 3 (<i>How can context-aware technologies be used in enhancing CDM amongst stakeholders involved in counter-terrorism?</i>)	Thematic Analysis (TA)

3.6.1 Thematic Analysis

Thematic Analysis (TA) is a qualitative method for identifying, analyzing, organizing, describing and reporting themes found within a data set (Braun & Clarke, 2006). TA is one of the qualitative research methods that can be used across a range of epistemological and research questions (Nowell, Norris, White, & Moules, 2017). However, despite its flexibility and popularity, literature on TA in comparison to grounded theory, ethnography and phenomenology is limited (Nowell et al., 2017). Table 3-11 presents the step by step process for conducting TA.

Table 3-11: A step by step process for TA (adapted from Braun and Clarke, 2006)

Steps	Activities
#Step1:Data familiarization	<ul style="list-style-type: none"> ✓ Transcribing the data (if necessary), ✓ Reading and a re-read at the data sources ✓ Jotting down initial ideas
#Step2: Initial coding	<ul style="list-style-type: none"> ✓ Coding interesting features of the data in a systematic fashion across the entire data set ✓ Collating data relevant to each code
#Step3:Theme search	<ul style="list-style-type: none"> ✓ Collating data into potential themes ✓ Gathering all data relevant to each potential theme
#Step4: Review of themes	<ul style="list-style-type: none"> ✓ Vetting the created themes and sub-themes (checking whether the themes work in relation to the coding extracts) ✓ Generating a thematic ‘map’ of the analysis
#Step5:Defining and naming themes	<ul style="list-style-type: none"> ✓ Re-defining the specs of each theme ✓ Generating clear definitions and names for each themes
#Step6: Producing the report	<ul style="list-style-type: none"> ✓ Final analysis of selected extracts, relating back to the research question and previous literature on the topic ✓ Write up of a scholarly report of the analysis.

Step 1: Data familiarization

Qualitative data comes in many formats including but not limited to documents (pdfs, texts, docs), recorded videos and observations, photographs, policy manuals, narratives etc. (Nowell et al., 2017). Irrespective of the data collection format, the

collected data should be archived and benchmarked for future data analysis (Lincoln & Guba, 1985). It is also advisable for one to familiarize themselves with the data by having a deeper understanding of the data set (Braun & Clarke, 2006). Data familiarization include: transcribing of the data, jotting of initial ideas, and a continuous re-look at the data etc.

Step 2: Initial coding

This process involves creation of NODES from the data sources. A NODE is a common phrase that is picked up from the data sources. NODE creation assists in capturing and labelling key concepts from the data sources in relation to the objective of the study (King & others, 2004).

Step 3: Theme search

This step involves the sorting and putting together of the relevant coded data (NODES) and extracts or groups them into themes (Braun & Clarke, 2006; Nowell et al., 2017). A theme is an abstract entity that brings meaning and identity to recurrent experiences and its variant manifestations (DeSantis & Ugarriza, 2000). As such, a theme captures and unifies the nature or basis of the experience into a meaningful whole (p.362). Aronson (1995) indicates that themes are formed by putting together similar ideas, fragments or components which cannot be easily understood alone. While, DeSantis and Ugarriza (2000) observed that themes are important for linking portions of significant data together.

A theme can either be generated deductively or inductively (Boyatzis, 1998). Inductive theme generation involves coding the data without trying to fit it into a pre-existing coding frame (data driven) (Nowell et al., 2017). Whereas, the deductive theme generation involves coding the data and fitting it into a pre-existing categorization (driven by a theoretical or analytic interest) (Nowell et al., 2017).

Step 4: Review of themes

This step involves the refinement of the themes generated in step 3 with the aim of determining whether the extracted themes form coherent patterns (Nowell et al., 2017). This step also assists in the validation of the extracted themes by checking if

the themes are a true reflection of meaning as envisaged in the data sources (Braun & Clarke, 2006; Nowell et al., 2017). A re-look at the identified themes may also lead to the collapse of some themes to join with the others due to little information (data) to support them (Braun & Clarke, 2006).

Step 5: Defining and naming themes

In this step, the themes that survived the refinement process in step 4 are re-identified, re-grouped and re-named (Braun & Clarke, 2006). The importance of the re-defined themes are also re-stated so as to capture the envisage objectives of the study.

Step 6: Producing the report

This is the final step of the TA process. It commences once the themes have been fully established for sub-sequent analysis and write-up of the report (Braun & Clarke, 2006).

3.6.2 Soft Systems Methodology

Soft Systems Methodology (SSM) is both a problem structuring approach as well as an organized learning system that tries to address problematical (social) situations with no direct answers in an organized manner (Checkland, 2000; Checkland & Poulter, 2006). This methodology (soft systems) is well suited for handling messy and unstructured situations where there are many perspectives, values and believes that needs to be considered before taking any action (Checkland & Scholes, 1990; Rosenhead & Mingers, 2001). Figure 3-3 presents the seven stage process of the SSM approach (Checkland, 1999).

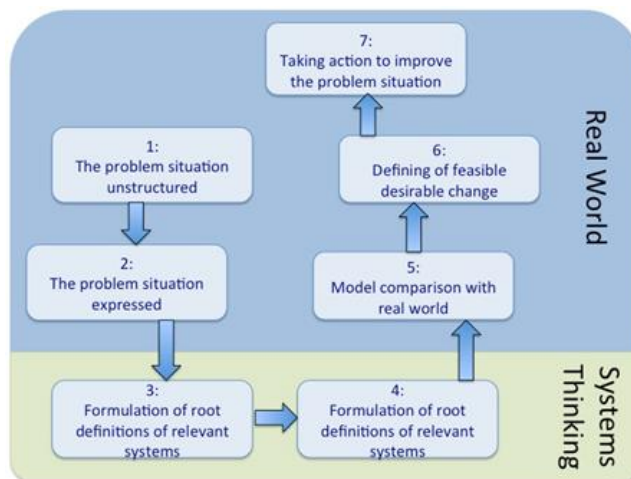


Figure 3-3: The seven step process of SSM (source: Checkland, 2000)

The seven stages of the SSM process as shown in Figure 3-3 occur in two different phases. Stage 1, 2, 5, 6, and 7” comprises of activities in the real world while “stages 3 and 4” involves activities in the system thinking. The activities in the respective stages are presented as follows:

Stage 1: The Problem Situation Unstructured

This is the initial stage of the SSM process. It is also referred to as the “finding out stage”. This stage involves the identification of the research problem by trying to understand and explore the problem situation. This is done through information gathering using both secondary and primary sources of information.

Stage 2: The Problem Situation Expressed

The second stage of the SSM process involves representation of the problem situation in the form of a “rich picture” with the assumption that more knowledge can be communicated visually (Checkland & Scholes, 1990). This second stage is important because it provides the researcher with necessary knowledge regarding cause and effect as the problem is conveyed in a “rich picture”.

Stage 3: Formulation of Root Definitions of Relevant Systems

Stages 1 and 2 as shown in Figure 4 occurs in the “real world” whereas stage 3 takes place in the system thinking world and involves the use of the “rich picture” developed in stage 2 to formulate the root definitions. The formulated root definitions are then used to propose possible solutions to the problem identified in stage 1.

According to Flood and Jackson (1991), root definitions are statements that describe the ideal system in terms of:

- Who needs to be in it?
- What activities need to be done?
- Who can be affected by it?
- Who can benefit from it?
- Who could affect it?
- What is its purpose?
- What are the environmental constraints limiting its actions and activities?

In developing these root definitions (stage 3) and conceptual model (stage 4), the problem under consideration are described using elements represented by the acronym CATWOE (see Table 3-12) (Tajino, James, & Kijima, 2005).

Table 3-12: CATWOE elements (adapted from Checkland and Scholes, 1990)

C = Customers	These are the victims and/or beneficiaries from the proposed system activities or transformation process (T).
A = Actors	These are the ones who take part in the activities or transformation process (T).
T = Transformation process	These are the activities undertaken by the actors which involve changing the system from input to output state.
W = Weltanschauung	This refers to the world view that makes the transformation process (T) meaningful or significant.
O = Owners	These are those with the power to either modify or stop the transformation process (T) from taking place. These may include but not limited to government, citizens, CEO's or even terrorists in this study.

E = Environmental	These are the constraints that inhibit the transformation process (T) from taking place.
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Although, root definitions are generally used for describing primary tasks; they can also be used to describe issue-based systems that reflect particular or general viewpoints. Grouping the root definitions using CATWOE is regarded as important since it provides a holistic view of all the actors involved in the problem.

Stage 4: Building Conceptual Models

Stage four takes place in the systems thinking world and the activities include the building of the conceptual model from each of the root definitions. This is done with the goal of providing guidance on the possible ways that can be used in addressing the research problem. It is this developed model that; provides guidance on the tasks to be carried out, the procedure to be followed in carrying out the tasks and who is responsible in carrying out the tasks (Sankaran, Chroust, Walker, Steinfort, & Maqsood, 2014).

Stage 5: Comparison of the Models with the Real World

This stage entails the comparison of the developed conceptual model (stage 4) to the real world. This process involves the identification of the system constraints and opportunities with the aim of refining the model further. This process can be conducted through interviews, observations, formal questions and matrixes as proposed by Checkland and Holwell (1998).

Stage 6: Defining of the Change

This stage involves the identification of the changes within the system environment. It requires a re-visit of the previous stages to establish the actions that warrant implementation (Stage 7). Checkland proposes a re-look at the “**CATWOE**” elements with the aim of avoiding possible challenges that might arise. In addition, Checkland (2000) identifies procedural, attitudinal and structural changes as the three categories of change. The implementation of the structural and procedural changes can easily be done by the relevant authorities. However, the implementation of the attitudinal change which relates to human activity is quite difficult and requires considerable monitoring to ensure its achievement. Equally, Checkland (2000) stresses

that before implementing any change, the identified change must be systematically and logically desirable and must be culturally acceptable.

Stage 7: Taking Action

This is the final stage of the SSM process and it involves the actual implementation of the identified changes in stage 6 with the aim of improving the problem situation.

The SSM technique together with thematic analysis was adopted in this study to assist with structuring the terrorism problem in the digital age.

3.6.3 Structural Equation Modelling

Structural Equation Modelling (SEM) is a multivariate, statistical technique that combines factor analysis and regression analysis (Ravand & Baghaei, 2016). It is widely used to study the relationships between latent (constructs) and observed variables that constitute a model (Qureshi & Kang, 2015). This is because of the technique's capability to simultaneously examine the indirect and direct relationships amongst causal variables while accounting for measurement error (Ali, Rasoolimanesh, Sarstedt, Ringle, & Ryu, 2018; Civelek, 2018).

SEM is composed of the measurement and structural model. The measurement model represents the relationship between each construct and its associated indicators, whereas the structural model represents the structural paths between the constructs (see Figure 3-4) (Chen, Zhang, Liu, & Mo, 2011; Civelek, 2018).

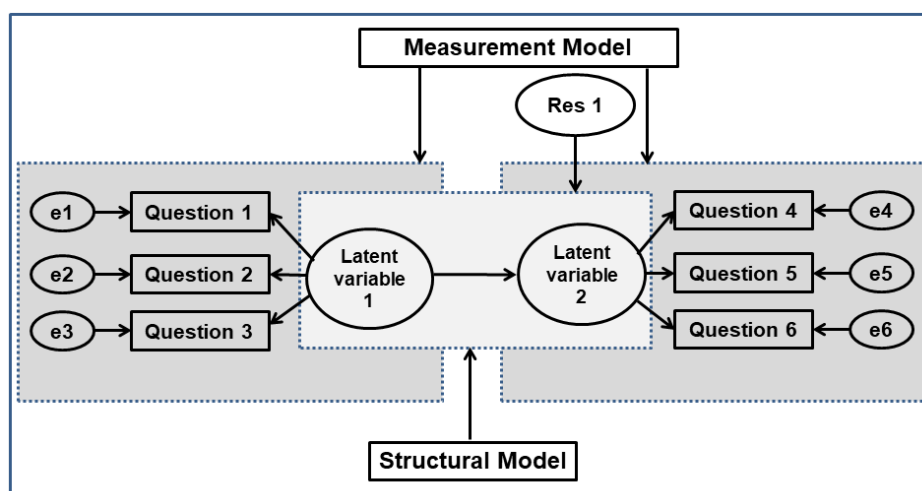


Figure 3-4: A path model showing structural and measurement model

In a path model, the variables can either be latent variables or observed variables (Civelek, 2018; Ringle, Sarstedt, Mitchell, & Gudergan, 2018). Latent (unmeasured) variables (represented by an eclipse in Figure 3-5), which are linked via single headed arrows, represent predictive relationships. In other words, these are variables which are of key interest but cannot be measured directly (e.g. information and knowledge sharing, organizational co-operation among others as shown in Figure 3-5). On the other hand, observed variables, which are visualized by a rectangle in a path model (Figure 3-5), are those that are directly measured during the data collection process and represent the raw data (e.g. respondents answers to a question) (Civelek, 2018; Qureshi & Kang, 2015). In a structural equation model, it is recommended that there should be at least 3 observed variables connected to a latent variable (see Figure 3-5).

Apart from being either a latent variable or an observed variable, these variables can also be considered as endogenous or exogenous variables. As shown in Figure 3-6, endogenous are variables that are dependent in nature but are explained by other variables (e.g. Z, T and W). On the other hand, exogenous variables are independent variables not explained by any variable (e.g. X and Y). It should be noted that in a path diagram if more than one exogenous variable exists, then covariance between them exists.

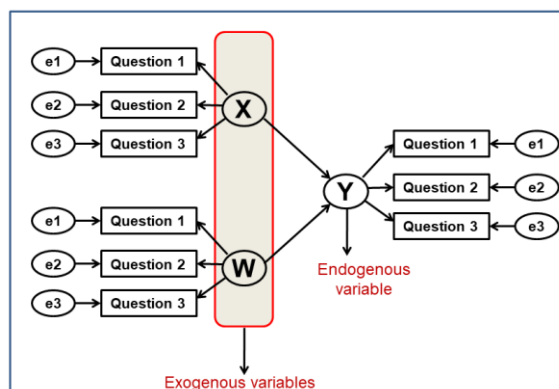


Figure 3-5: Endogenous and exogenous variables

There are two forms of SEM, namely variance based SEM also known as partial least squares SEM (PLS-SEM) and covariance based SEM (CB-SEM) (Avkiran, 2018; Memon, Ting, Ramayah, Chuah, & Cheah, 2017).

a) *PLS-SEM*

PLS-SEM is a non-parametric, multivariate approach based on interactive ordinary least squares (OLS) regression (Lohmöller, 2013). This technique is composed of three main components:

- the structural or inner model;
- the measurement or outer model; and
- the weighting scheme.

PLS-SEM is applicable to exploratory research, where the primary goal is theory extension or development (Memon et al., 2017). In other words, PLS-SEM fits well with studies whose objective is to predict and explain the key target constructs and/ or to identify the key driver constructs (Hair, Hult, Ringle, & Sarstedt, 2016). PLS-SEM focuses on the explanation of the variables, rather than covariance, making it a prediction oriented approach to SEM (Ali et al., 2018). PLS-SEM is good for models with either, both formative and reflective constructs, or only formative constructs (Memon et al., 2017). In a formative construct, the indicators cause or form the construct (e.g. salary is determined by level of education and gender). While, in a reflective construct, it is the construct that forms or cause the indicators (see Figure 3-6) (Ravand & Baghaei, 2016). Equally, PLS-SEM is good with situations where normality assumptions are violated (Hair et al., 2016). Nevertheless, despite the advantages of PLS-SEM, the technique has been criticised for giving biased parameter estimates since it does not explicitly model measurement error (Avkiran, 2018).

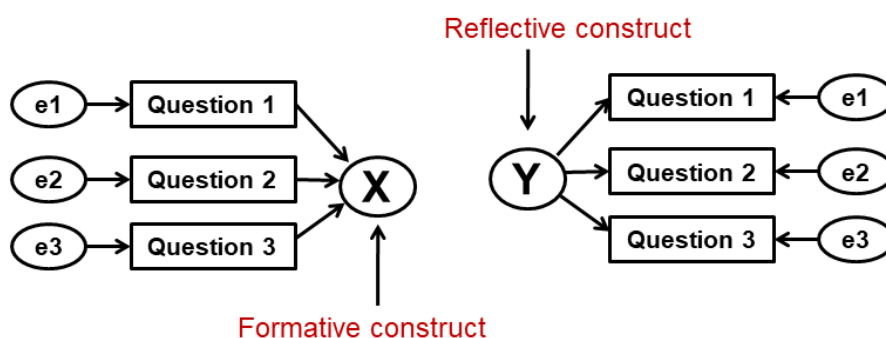


Figure 3-6: Formative versus reflective constructs

b) CB-SEM

Unlike PLS-SEM, CB-SEM is more suitable for explanatory or confirmatory research (Hair et al., 2016). In other words, the applicability of CB-SEM is more promising in research studies where the primary goal of the research is theory testing, theory confirmation or comparison of alternative theories. In addition, the usage of CB-SEM technique fits better for models with circular relationships or loops of relationships between latent variables (Hair et al., 2016). CB-SEM uses maximum likelihood estimation and because of this, it is inflexible in terms of data distribution and is therefore good for datasets with ideal data distribution (Memon et al., 2017).

Each of the two forms of SEM are appropriate for different research contexts (Hair et al., 2016). This is because they make different distribution assumptions and aim at different objectives (Ravand & Baghaei, 2016). Thus, as suggested by Memon et al., (2017), the characteristics and objectives of a research study should be the guiding factors for using either PLS-SEM or CB-SEM. In this study, based on the features and characteristics of PLS-SEM, its strategic use in marketing, information systems, strategic management, hospitality management, accounting and tourism amongst others (Ali et al., 2018; Nitzl, 2018) and since PLS-SEM is capable of handling smaller sample sizes (minimum sample of 30) (Garson, 2016; Vinzi, Chin, Henseler & Wang, 2010), it was deemed suitable for the attainment of the second research objective in this study: “***What are the key factors influencing collaboration in decision making amongst stakeholders involved in counter-terrorism***”.

3.7 PARTICIPANT SELECTION

The participants in this study were identified using purposive sampling technique - particularly, the homogeneous sampling method was adopted. Purposive sampling, also known as judgment sampling, is a non-probabilistic sampling technique that requires neither the underlying theories nor a set number of participants. This type of sampling techniques involves deliberately choosing people as participants in a study based on their qualities (Etikan, Musa, & Alkassim, 2016). The sampling process involves, identifying and selecting individuals or group of individuals that are proficient and well informed with a phenomena of interest (Etikan et al., 2016). The chosen sample is supposed to be willing and be in a position to provide information by

virtue of knowledge and experience (Bernard, 2011). Table 3-13 outlines the population and the proposed sample sizes used in the study.

Table 3-13: Population and sample sizes

Question	Population	Sample size
Sub-Question1	None	None
Sub-Question2	Police, intelligence services, immigration department, criminal investigation unit, anti-terrorism units	176
Sub-Question3	Technology experts, scholars in security studies	2*6=12

3.8 RELIABILITY AND VALIDITY

A research instrument is referred to as valid if it has the capability of measuring what it is supposed to measure and accurately achieve its purpose. According to Patten (2004), there is no test instrument that is perfectly valid. Therefore, it is the role of the researcher to find some assurance that the used instrument will result into a good result (Wallen & Fraenkel, 2001). Reliability is linked to the consistency of the collected data (Wallen & Fraenkel, 2001). Cronbach's coefficient is used to determine the internal reliability of the developed instrument and was accordingly also used in this study. Validity relies majorly on usefulness, meaningfulness and appropriateness of the inferences made by the researcher based on the collected data (Wallen & Fraenkel, 2001). There are different forms of validity such as content validity and construct validity.

- **Content Validity** - Also termed as face validity refers to “the extent to which an empirical measurement reflects a specific domain content” (Thatcher, 2010, p.125-141). To ensure improved *content validity*, Patten (2004) proposes three principles that needs to be looked into: (1) use of questions to measure appropriate skills; (2) emphasize on relevant materials; and (3) use of a broad sample content.
- **Construct Validity** - “Is the extent to which a particular measure relates to other measures [that are] consistent with [a] theoretically derived hypothesis concerning the concepts that are being measured” (Thatcher, 2010, p.147).

In this study, reliability and validity were taken into consideration.

3.9 ETHICAL CONSIDERATIONS

Before conducting the research, University of Venda Ethics Committee granted ethical clearance for conducting the study (see Appendix B). In addition, National Commission for Science, Technology and Innovation (NACOSTI) also permitted the researcher to continue with the study (see Appendix C). During the data collection phase the researcher practiced the principle of informed consent. In that the participants were introduced to the study and informed of the objective of the research. In addition, they were also informed that participating in the study was voluntary and therefore, they had a choice to either participate or not. Further, it was also brought to their attention that anonymity throughout the research process would remain. In that, their identity will not be used or published at any stage of the research. The participants were also assured that their data/information would be treated with high confidentiality.

3.10 SUMMARY

Figure 3-7, gives a summary of the overview of the research design adopted in the study. In the next Chapter, the analysis for research question one is given.

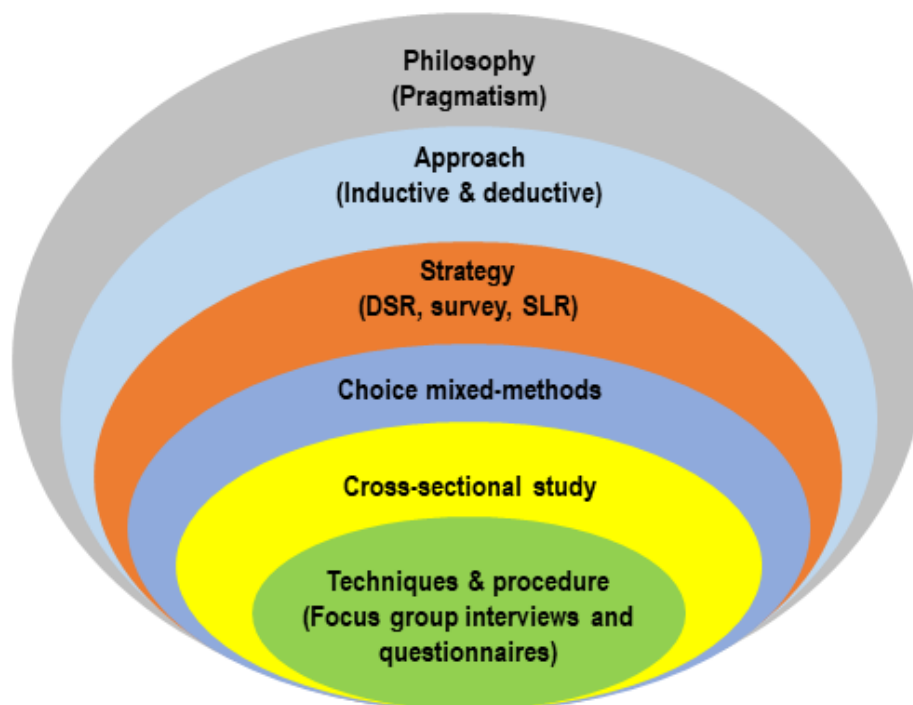


Figure 3-7: Overview of the research design used in this study

Chapter 4: Digitalization of Terrorism Ecology: A Systems Perspective

4.1 INTRODUCTION

This Chapter ¹²focuses on how the terrorism problem can be structured in the digital age (*research-question 1*). The terrorism problem in this digital age is becoming more of a technological problem. This is evidenced by the increase in use of digital technologies both by the terrorists in recruiting and training, coordinating attacks and even soliciting funds (Odhiambo, Ochara, & Kadymatimba, 2018). Therefore, social and political solutions used in isolation for counter-terrorism are not sufficient in mitigation, preventing and containing terrorism and its associated effects (Mujinga, Eloff, & Kroeze, 2017). Thus, in this Chapter the goal is to highlight the role digital technologies play in *modern day* terrorism ecology. In achieving this objective, the theory of synergetics is used as a theoretical lens and Soft Systems Methodology (SSM) adopted.

The rest of the Chapter is organized as follows. In Section 4.2, the unstructured nature of the terrorism problem is given, followed by a presentation of the research methodology (Section 4.3). The results are given in Section 4.4, conclusions in Section 4.5 followed by a Chapter summary in Section 4.6.

4.2 UNSTRUCTURED, COMPLEX, MESSY PROBLEMS

According to Rittel and Webber (1973), unstructured, complex, messy problems are a type of problems whose solutions are difficult, since they lack complete information, they are unique in nature, their causal-relationships are multi-twinned,

¹ Conference version of the chapter published as: Ochara, N. M., & Odhiambo, N. A. (2018, May). Sociomateriality of Digital Technologies in Collaborative Decision-Making Counter-Terrorism Contexts. In *ICMLG 2018 6th International Conference on Management Leadership and Governance* (p. 219). Academic Conferences and publishing limited.

²Conference version of the chapter published as: Odhiambo, N. A., Ochara, N. M., & Kadymatimba, A. (2018, October). Structuring of the Terrorism Problem in the Digital Age: A Systems Perspective. In *2018 Open Innovations Conference (OI)* (pp. 148-154). IEEE

³ Article version of the chapter is under review in the African Journal of Information & Communication (AJIC)

their solutions require multiple stakeholders etc. Problems such as terrorism can be considered messy, unstructured and complex because its solution warrants the input of stakeholders with diverse backgrounds and from different organizations e.g. security organizations, governments, non-profit organizations, international organizations, religious organizations and citizens, amongst others. Its mitigation requires multiple considerations such as; the lack of universal definition, the various forms of terrorism (e.g. domestic, transnational), changes in *modus operandi* of the terrorists', religious fundamentalism amongst others. Thus, in order to get a clear understanding of the terrorism problem, Hester, Collins, Ezell and Horst (2016) state that problem structuring and collaboration amongst the stakeholders' involved is crucial.

Problem structuring is the process of arriving at an appropriate understanding of a problem so as to proceed to some sort of formal modelling (Hester et al., 2016). Additionally, Raiffa, Hammond and Keeney (1999) indicate that articulating the correct problem is important since both problem solution and evaluation is dependent on how the problem is framed. Therefore, problem structuring is important in instances where multiple stakeholders are tasked with evaluating and solving the problem solution, as in the case with terrorism. This multiple actors also out to take cognizant of the fact that the terrorism ecology is constantly evolving with advancements in the digital space. Hence, their actions if anchored on the said digital space are not only tractable to them but also to terrorists themselves. It is this conundrum, which informs this Chapter.

Problem Structuring Methods (PSM) emerged in the late 1970's due to failures experienced with the hard Operations Research (OR) methods such as decision analysis (Ackermann, 2012). Due to the challenges faced by hard OR methods, Ackoff (1981) and Rittel and Webber (1973) proposed soft OR methods such as SSM (see Chapter 3, Section 3.6.2) to assist in the solution of messy, complex and unstructured problems.

4.3 RESEACH METHODOLOGY

A systematic literature review (SLR) was used to identify the most relevant studies, papers and reports on how digitalization is currently entangled with terrorism and counter-terrorism ecology. An approach integrating SSM and meta-synthesis was applied to aid in evaluating the relevant articles. The methodological process of SSM (Checkland, 2000) involves seven steps: (1) Un-structuring of the problem situation

(2) Expressing of the problem situation (3) Formulation of root definitions, (4) Model comparison with the real word (5) Formulation of root definitions of relevant systems (6) Defining of feasible desirable change and finally, (7) Taking action. Meta-synthesis is one of the qualitative methodologies that can be applied in synthesizing outcomes of several studies similar in topic or in the outcome measure (Park & Gretzel, 2007).

Both peer-reviewed and non-peer reviewed data sources i.e. books, magazines, articles, blogs, reports, newspapers, websites and videos were used as data sources in this study. They were from scholarly electronic databases such as Elsevier, ProQuest, Sage Publications and Web of Science. In addition, Google Scholar and Google search engines were also used to search for more relevant sources. Table 4-1 presents the key search terms that were used to identify only the specific documents in relation to the research question in this study.

Table 4-1: Key search terms used

Key Search Terms	Key Search Terms	Key Search Terms
Terrorism	Extremism	Ideology AND Terrorism,
Counter-Terrorism	Radicalization	Definition of Terrorism
Religion AND Terrorism	Policies AND Terrorism	Technology AND Terrorism
Root Causes of Terrorism	Forms of Terrorism	Counter-Terrorism AND Technology
Radicalization AND Terrorism	Poverty AND Terrorism	Terrorism AND Facebook
Terrorism AND the modes of operandi	Governance AND Terrorism	Terrorism AND Twitter
Terrorism AND Internet,	Terrorism AND You-Tube	Terrorism AND Social Media
Counter-Terrorism AND Twitter	Counter-Terrorism AND Training	Counter-Terrorism AND Social-Media
Research AND Terrorism	Europe AND Terrorism	Terrorism AND USA,
Africa AND Terrorism	Human Rights and Terrorism	Terrorism Organizations
Terrorism AND ISIS	Terrorism AND AL-Qaeda	Terrorism AND Osama
Terrorism AND Al-Shabaab	Terrorist Groups	Terrorism AND propaganda
Terrorism AND Recruitment	Terrorism AND Training	Counter-Terrorism AND Organizational Culture
Counter-Terrorism AND Collaboration	Terrorism AND Media	Counter-Terrorism AND Institutional Rivalry
Counter-Terrorism AND Organizational Structure	Counter-Terrorism AND Policy	Counter-Terrorism AND Human Rights
Community Policing AND Terrorism	Terrorism and Boko Haram	Counter-Terrorism AND Boko Haram
Counter-Terrorism AND Media	Counter-Terrorism AND Facebook	Counter-Terrorism AND You-Tube

The search focused mainly on English articles post 9/11 due to the increase in research on terrorism post 9/11. The Internet search resulted into more than 4337 documents. The inclusion and exclusion process involved removal of duplicates, scanning through the titles and abstracts and checking through the Section on references of the identified documents. The references were checked to identify whether more documents could be included in the list. At the end of the inclusion and exclusion process, 405 documents were identified for thematic analysis (Figure 4-1). A deductive thematic analysis based on SSM and the theory of synergetics was conducted.

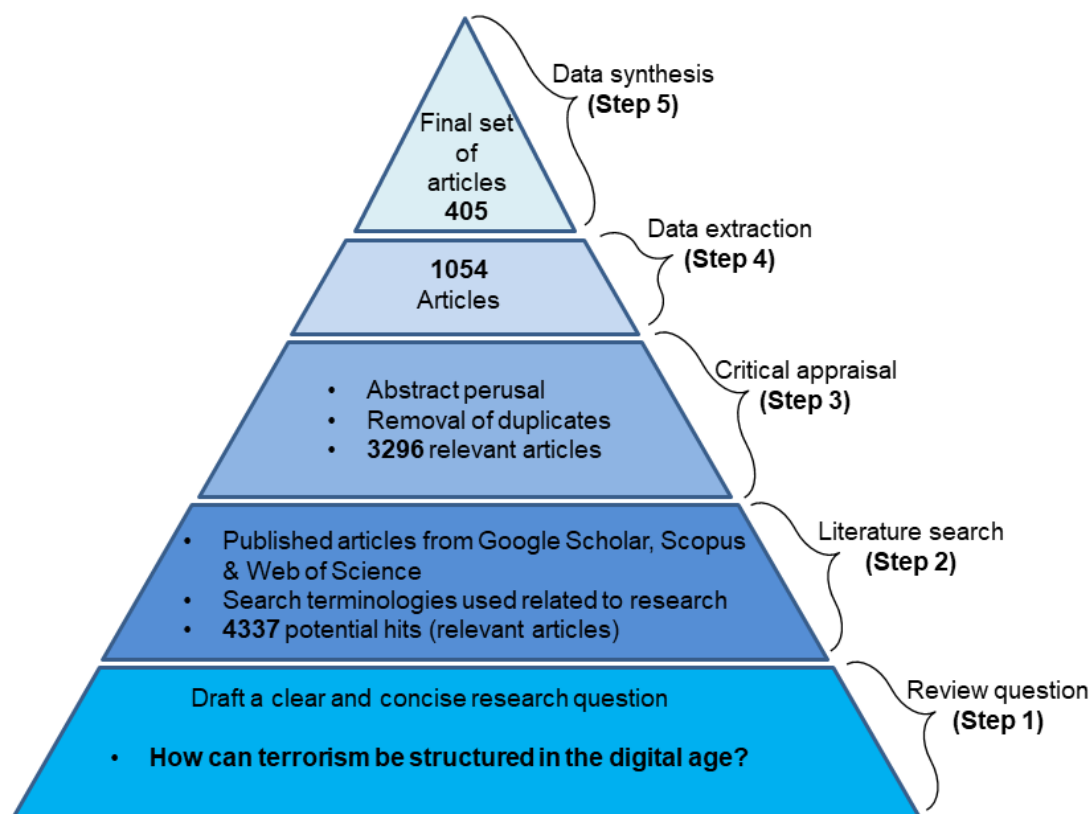


Figure 4-1: The systematic process followed to identify the documents

Theoretical thematic analysis was used in analysing the data collected from the meta-synthesis. Thematic analysis is one of the qualitative analysis used to analyse classifications and present themes (patterns) that relate to the data (Alhojailan, 2012). The step by step approach adopted in this study is presented in Chapter 3, Section 3.6.1 of this thesis.

4.4 RESULTS

This Section presents the results of the meta-synthesis and the development of a conceptual model from the analytical framework: the theory of synergetics.

4.4.1 Meta-Synthesis Research Categories

Given the theoretical underpinnings based on the theory of synergetics, theoretical thematic analysis was the mode of analysis undertaken in this study. This required that the final 405 final set of articles (Figure 4-1) be mapped onto the components of the adopted theory, i.e. the theory of synergetics. Based on the guidelines by Ochara (2013), the theory of synergetics was used for data interpretation. Table 4-2 below provides a guidepost of the distribution of the final set of papers and their relevance.

Table 4-2: Category guidelines following theory of synergetics

Components	First order coding	Number of articles
Control parameters	<ul style="list-style-type: none"> ✓ Regional economic imbalance <ul style="list-style-type: none"> ➤ Poverty & Grievances ➤ Extremism, ✓ Poor governance ✓ Technology (Media & Internet) 	73
Environment	<ul style="list-style-type: none"> ✓ Definitions of terrorism ✓ Multiple agencies ✓ Changing modes of attack ✓ Improved access and availability of technology 	149
Internal and external constraints	<ul style="list-style-type: none"> ✓ Institutional rivalry ✓ Organizational perspectives <ul style="list-style-type: none"> ○ Norms & Values ○ Roles & Responsibilities) 	18
Internal and external parameters	<ul style="list-style-type: none"> ✓ Complexity of inter-organizational cognitive behaviour ✓ Complexity of cross-organizational competencies 	34
Order parameters	<ul style="list-style-type: none"> ✓ Dominant ideology <ul style="list-style-type: none"> ○ Philosophy ○ Root causes ✓ Policies ✓ Open models of information sharing <ul style="list-style-type: none"> ○ Collaboration ○ Sharing economy ○ Open technology platforms etc. 	94
System elements	<ul style="list-style-type: none"> ✓ Collective intelligence ✓ Open governance models <ul style="list-style-type: none"> ○ Collaboration ○ Transparency ○ Participation etc. 	37

Given the approach to the mode of analysis, i.e. theoretical thematic analysis, the components of the theory of synergetics were then used as a guide to theory development in the discussions Section. The distribution of these articles was considered sufficient to allow for the SSM approach be applied.

4.4.2 CATWOE Analysis

Braun, Clarke and Terry (2014) envisage three steps related to data familiarization, generation of initial codes and theme search as critical and distinct steps in thematic analysis. From a deductive (theoretical) thematic analysis process, the CATWOE process of SSM provides an intuitive approach that can adopt these three steps to evolve both a word cloud (Figure 4-2) and a table that summarizes the high-level initial themes or first order themes (see Table 4-2). The initial descriptive NODES as obtained using NVIVO, the qualitative analysis software, are attached in the appendix of this thesis (appendix A). The word cloud was developed from these initial NODES (see Figure 4-2).

CATWOE is a mnemonic representation of six terms: Customers, Actors, Transformation, Weltanschauung, Owner and Environmental Constraints. The six elements of CATWOE are essential for the development of the root definitions of a proposed “system” (Checkland, 1981, p.225). The CATWOE elements are represented in Table 4-3 below.



Figure 4-2: Word cloud visualization

Table 4-3: CATWOE analysis

C	Customers	Government, state, community, individuals, terrorists, Al-Qaeda, ISIS, people, public, group, organisations, society, companies, human, university, international, countries,
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A	Actors	Technology, social-media, twitter, Facebook, computer and Internet, community, government, websites, organisations, video, system, digital, political, police, press, human, university, media, social, computer, people, individuals, society, community
T	Transformation	Policy, strategy, communication, frameworks, analysis, content, activities, technologies, data, work
W	World View	Islamic, political, national, privacy, rights, counter-terrorism, surveillance, terrorism,
O	Owners	Technology, social media, twitter, Facebook, computer and Internet, government, community, organisations, videos, journalists, companies, system, digital, police, press, university, media, twitter, information, social, online, computer
E	Environmental Constraints	Support, attacks, material, violence, services, intelligence, effective, strategy, threat, techniques, news, approach, information, terror, privacy, enforcement, program, cyber-terrorism, war, AI, struggle, propaganda

Table 4-3 illustrates the CATWOE elements and the resulting categorization from the word cloud (Figure 4-2). In an SSM analysis, Customers (C) refer to the beneficiaries or victims affected by the system under consideration (Checkland & Scholes, 1990). In our analysis, the digital terrorism ecology is what is under consideration. Under the categories of customers, the analysis revealed the following representations: the government, state, community, individuals, terrorists, Al-Qaeda, ISIS, group, organisations, society, companies, human, university, international and countries. What is apparent is the range of representation of individuals and groups that are either beneficiaries or victims within the terrorism ecology.

From an SSM perspective, actors are the agents who carry out the main activities of a system (Checkland & Scholes, 1990). Under the actors' Section of Table 4-3, what is apparent is the dominance of digital technology themes identified as technology, social-media, twitter, Facebook, computer, Internet, websites, video, system and digital. The third aspect of CATWOE is the Transformation, which focuses on the purposeful activities undertaken by the actors with the aim of solving a problem (Checkland & Scholes, 1990). From the context of terrorism ecology, transformation is viewed as process or artifacts that influence the *evolution, nature* and *forms* of interactions between the multiple stakeholders. As shown in Table 4-3, the identified themes in the transformation process include: policy, strategy, communication, frameworks, analysis, content, activities, technologies, data and work.

The Worldview in SSM is explicated as connected to an individual's worldview and beliefs, and gives transformation meaning (Bergvall-Kåreborn, Mirijamdotter, &

Basden, 2004). Key themes identified (Table 4-3) and linked to worldview are: Muslim, political, national, privacy rights, counter-terrorism and terrorism. From the analysis, themes related to the ethos of *religion, politics, nationalism, digital rights* and *response* to the terrorism problem are prevalent. The Owners (Table 4-3) are those with the power to either stop the transformations from taking place or allow it (Checkland & Scholes, 1990). As per Table 4-3, the visibility of digital technology artifacts (technology, social media, twitter, Facebook, computer, Internet, videos, system, digital, twitter, information, social and online) points to a *relational view of power*, regarded as capacity for action that resides in social relations (Doolin & Mcleod, 2012).

Environmental constraints (E) are considered as the internal or external limitations that can hinder the Transformation process (T) from taking place (Bergvall-Kåreborn, Mirijamdotter and Basden 2004). From Table 4-3, several constraints were identified that fall into three groups. The first group, largely deriving from Internet infrastructure can be named *Information Load* constraints comprising of themes such as news, privacy, Artificial Intelligence (AI), propaganda, information and intelligence. The second group of constraints is linked to the problem of adequately structuring the terrorism problem and can be named *Dynamism of Terrorism*.

4.4.3 Rich Picture of the Digital Terrorism Ecology

The rich picture (Figure 4-3) as part of SSM analysis is a precursor to the conceptual model based on the theory of synergetics (

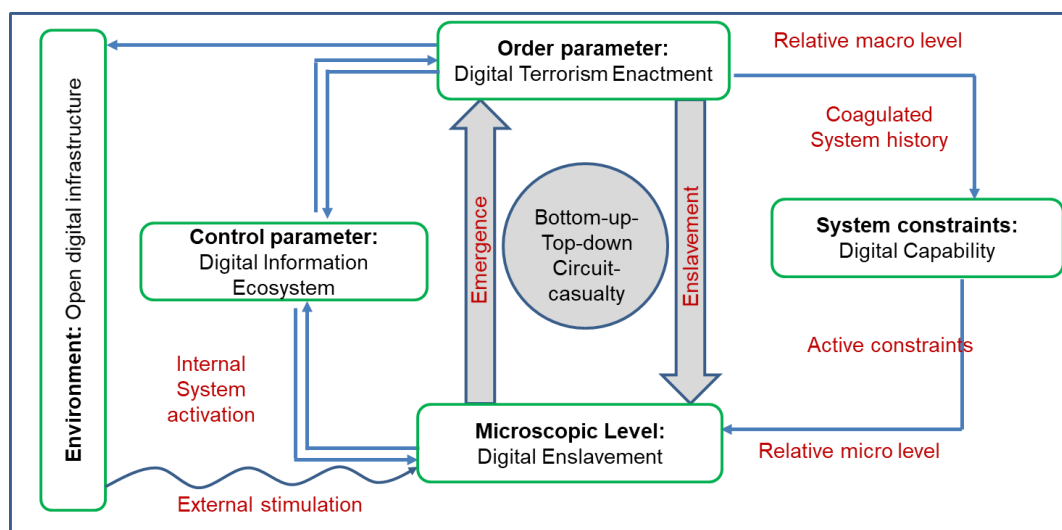


Figure 4-4). The pervasive role of digital technology, from a problem structuring perspective, allows it to play a pivotal role in the conceptual model. This pivotal view

of digital technologies in human systems finds traction in sociomateriality literature (see Cecez-Kecmanovic et al. 2014) and how affordances and capabilities of such technologies play a critical role in agency (Weißenfels, Ebner, Dittes, & Smolnik, 2016). For instance, Daniel, Hartnett and Meadows (2017) forcefully argues that social media’s democratizing affordances is evident in the transformation of power structures from top-down to much more bottom-up power. Evidence of such democratizing affordances is visible in the role that digital technology has played in the analysis above.

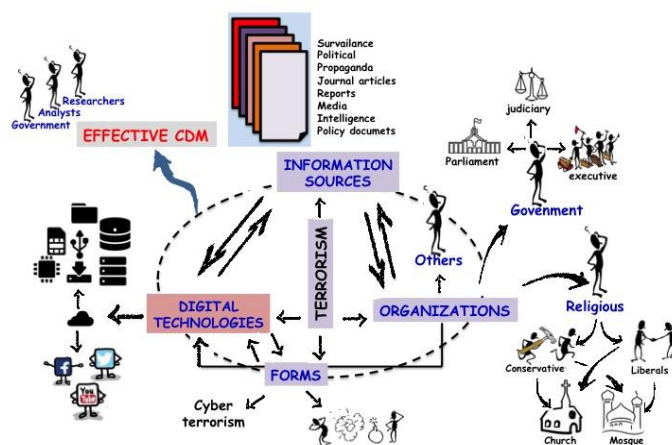


Figure 4-3: Rich picture of the terrorism ecologies

Further, the information sources are essential for developing policies and strategies for countering-terrorism. Similarly, these information sources are important to the governments/state in understanding the new forms and different forms of terrorism. For instance, with increased online access to information, the terrorists also develop counter-strategies for counter-terrorism strategies by the governments. In addition, increased online access through digital technologies such as Twitter, Facebook and You-Tube has empowered the terrorists such as ISIS and Al-Qaeda in advancing their propaganda and recruiting new members. This has made non-Muslim religious groups, non-governmental organisations as well as governments such as the USA to hold the view that it is Islam as a religion that encourages the terrorism agenda (von Sikorski, Schmuck, Matthes, & Binder, 2017).

4.4.4 Conceptual Model of the Digital Terrorism Ecology

Based on the underpinning theory of synergetics, the following discussion emerges from the analysis above to evolve a typology of Digital Terrorism Ecology.

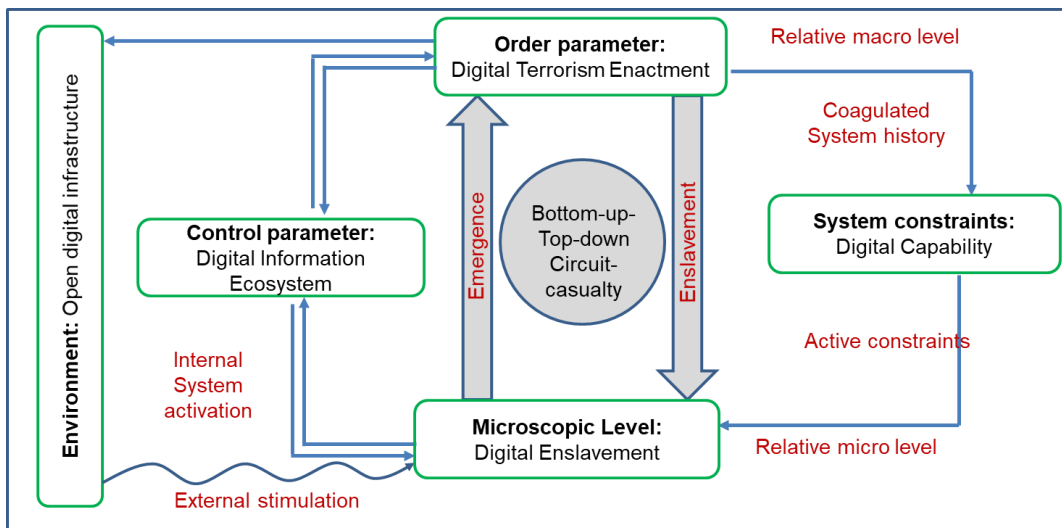


Figure 4-4 depicts the Synergetic Digital Terrorism Ecology (DTE) model that is derived from the analysis and synthesis of results to conceptualize the terrorism ecology as a complex system. As was discussed in the presentation of the analytical framework, the theory of synergetics core properties relate to *order parameters*, *control parameters*, *the microscopic system level*, *the macroscopic system level*, *system constraints* and *the environment*. The elements of the theory of synergetics are used as a second order ‘structuring’ tool to evolve sociotechnical ecology of terrorism. Through the resulting model, the nature of terrorism from a systems perspective is amplified, particularly, new understandings that illuminate the interrelationships between *open digital infrastructures*, *digital information ecosystem*, *terrorism policies*, *terrorism genres* and *the organizing forms* that ‘structure’ the terrorism artefact.

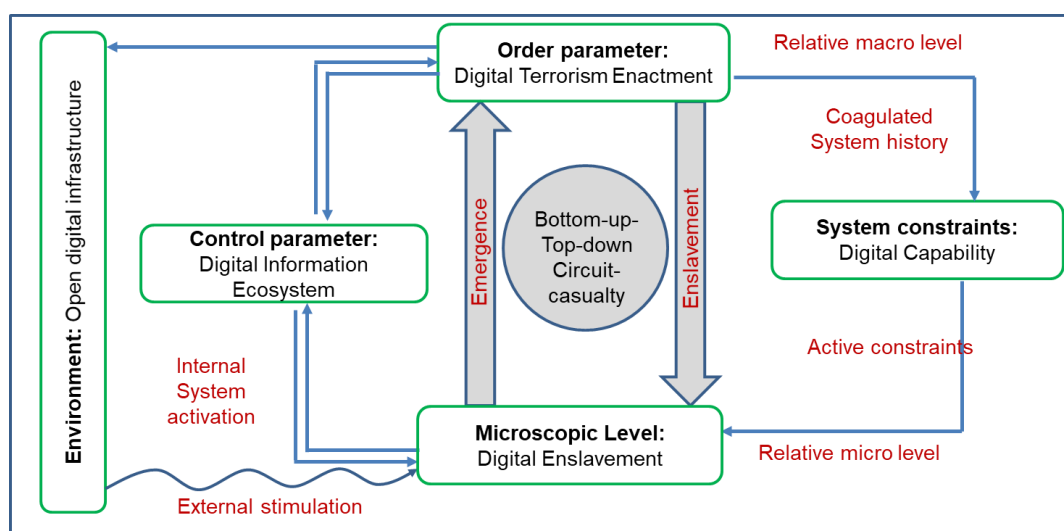


Figure 4-4: DTE framework

From a synergetic perspective, the *structuring* process of terrorism starts with an external activation from the *Digital Information Ecosystem (Control Parameters)* context of a specific actor or multi-actor group (*Microscopic Level*). The impulse from the DIE context kindles a random behavioural change process of terrorism genres at the *microscopic* level of system elements (*Terrorism Genres*), which leads/may lead to the emergence of new stabilized terrorism policies (e.g. community policing, counter-terrorism strategies, human rights, etc.) at the Macroscopic Level, that in turn ‘enslave’ the microscopic elements into particular, but unforeseen pattern(s) and unpredictable patterns of behaviour. To understand the process of emergence, a careful analysis of the control parameter (the DIE context) need to be carefully interpreted. The intent in pursuing a course of careful analysis and design of the DIE is to increase the likelihood of emergence of a dominant terrorism policy (order parameter) that undergirds a positive behavioural change in society, rather than emphasizing terrorism genres that stigmatize certain Sections of society. A deeper discussion of the evolved DTE model (

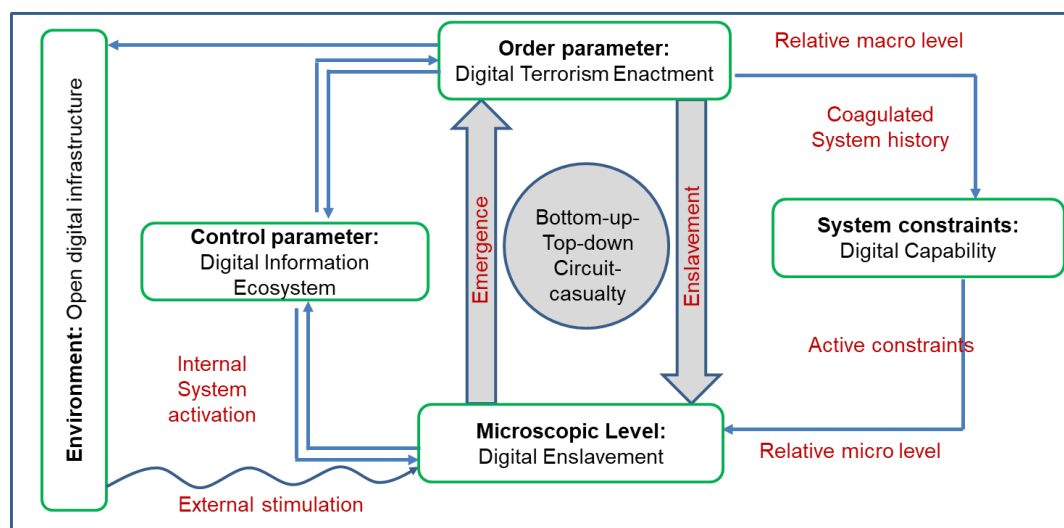


Figure 4-4) is explained in detail in the ensuing Sections. We look at the properties in turn by first making inferences related to the environmental aspects of the DTE, followed by looking at the control parameters, system elements, order parameters and system constraints.

4.4.4.1 *Environment: Open Digital Platforms-as-Infrastructure*

A critical underlying principle for the self-organization process is the necessity for the openness of systems, which allows *power* to be added externally through the environment. We advance the inference that the technology theme (from the previous analysis), particularly *digital technologies* (ICTs) is the core construct that undergirds

the emergence of the *terrorism genre* in its current form. Why? The first recognition being that for terrorism to be a problem, it must have changed in form (magnitude, severity, operations, etc.). Any casual analysis reveals that in all aspects (severity, magnitude and operations) the ‘structure’ of terrorism has become more complex since the 1960s. For instance, while in the 1960s and 1970s the predominant fear of terrorism was the proliferation of nuclear black markets and nuclear attack; to date, such fears have not been realized, while the magnitude, intensity and severity of terrorism have increased (Jenkins, 2006). Secondly, we place dramatic change in the nature of terrorism on the advent of the Internet infrastructure (Denning, 2010; Benson, 2014), due to its characteristic *openness* that enhances networking and increased capability of the terrorism genre. The identification and role of digital technologies in the analysis above confirm the dominant view that the emergence of wider sociomaterial infrastructures such as the Internet continue to reshape our current society (Merali, 2006), with implications on increased global terrorism (Gillespie, Osseiran, & Cheesman, 2018). Therefore, we view the current sociomaterial digital infrastructure as the environmental nexus that continues to ‘structure’ the terrorism ecology.

The open nature of digital infrastructures for terrorism is recognized to be underpinned by newer digitalization paradigms such as cloud computing, Big Data, transparent computing and nomadic computing (Odero, Ochara, & Quenum, 2017). We view these newer computing paradigms, underpinning and/or augmenting current digital infrastructures, as providing complimentary *affordances*, which were non-existent before, but currently provide possibilities that can aid in better structuring of the terrorism ecology, critical for better understanding. This view is especially relevant in “open” digital infrastructures, described as open, shared, heterogeneous systems that evolve through technology and actors; and include interdependent and interconnected collections of technical components, operating across organizational boundaries and community spaces (Tilson, Lyytinen, & Sørensen, 2010). We employ the notion of *affordance*, a concept originally from evolutionary biology and broadly defined as a *possibility for action* (Bygstad, Munkvold, & Volkoff, 2016), as a structuring device to aid in understanding the generative mechanisms that influence (*digital*) *information ecosystem* in the terrorism context.

To understand the nature of the influence of open digital technologies on terrorism ecologies, we adopt the perspective of technology affordance to reify the potentials of the emerging features of such newer digital technologies and

infrastructures. From a *relational perspective*, based on social interactions that shape and are shaped by the technology and the context (Carugati, Fernández, Mola, & Rossignoli, 2018), the evolving open digital infrastructure for terrorism emphasize that the focus should not be based on the features that digital technologies possess, but how actors' goals and capabilities can be related to the inherent *potential* offered by the features (Autio, Nambisan, Thomas, & Wright, 2018). Thus, the locus of the environmental aspect of Open *Digital Infrastructures* (ODI) places at the fore how open and flexible affordances of digital technologies enable 'newer' *Digital Information Ecosystem* (DIE) (the control parameter) that occasion change in behaviour within terrorism ecology. The dominant affordances that facilitate the engagement of terrorism ecology with the ODI as an enabler of DIE are social media vehicles such as Facebook, Twitter, Instagram and others (see the CATWOE and Rich Picture analysis), empowered by social software and algorithms, and enabled by smart devices (Tuten & Mintu-wimsatt, 2018). Certainly, prior research entrenches social media vehicles as the core proxy for open digital infrastructures (Paganini, 2016; Blaker, 2015; Plantin, Lagoze, Edwards, & Sandvig, 2018) with their characteristics of a : *the sharing economy and open digital technology platforms* influencing contemporary information ecologies of terrorists. The *sharing economy* or *gig economy* is seen as the most promising contemporary organizing principle influencing how human beings share knowledge and assets, enabled by the increased connectivity, scale, speed and transparency of the Internet (Burtch, Carnahan, & Greenwood, 2018).

4.4.4.2 Control Parameter: Digital Information Ecosystem

The environmental influence of ODI enables the control parameter of *Digital Information Ecosystem* (DIE), which has the power of influencing an emergent system (digital terrorism ecology) at the macro-level. The evolution of DIE as a control parameter can be explained using the concept of digital *counter-power* in the manner used by Castells. According to Castells (2011, p.773), "[...] wherever there is power, there is counter-power, enacting the interests and values of those in subordinate positions". We use the notion of *digital counter-power* to interpret the link between the first order themes that emerged from the CATWOE categories and the subsequent synergetic second order themes. The first order themes that were identified (Table 4-3) emphasized poor governance and regional economic imbalances that fuels and entrenches poverty, grievances, and extremism. Further, technology (particularly digital media and the Internet) has emerged as a forceful equalizer, empowering

billions with access to information. The second order emergent themes (CATWOE) analysis can be linked to the component of ‘*World View*’, which was characterized by the following concepts: Islamic, political, national, privacy, rights, counter-terrorism, surveillance, terrorism. While the first order themes related to “*economic imbalances and poor governance*” pointing to the ‘root causes’ of terrorism (Newman, 2006); the second order themes points to emergent ‘world views’ that are increasingly mediated by digital technologies (Bertram, 2016).

We link the causal relationship between the ‘root causes’ and emergent ‘world views’ to the notion of *counter-power*. While Castells’ account of counter-power remained predominantly focused on cultural and political resistance in the form of protest (David, Kirton, & Millward, 2017), here, we explore the case of *digital counter-power*, linked to the emergence and use of Internet sources of information as a powerful alternative that shapes our society’s worldviews in contradiction to mainstream views perpetuated by state and non-state actors globally. Research has established that the Internet continues to be a powerful influence of political protest (Hajj, McEwan, & Turkington, 2019), visible in contemporary digital counter-power network uprisings such as the ‘*Arab Spring*’ (see Elsayed & Wahba, 2019) and ‘*Black Lives Matter*’ movement (see Honwana, 2019) whose origins are associated with the excesses of the state and other powerful agencies. Thus, from the point of view of the analytical frame, the control parameter can be viewed through the lenses of *digital Counter-power* as a legitimization tool that links the emergence of terrorism genres to the forceful mediation of Internet sources of information shaping the worldview of the terrorist. As Hajj, McEwan and Turkington (2019) found out, Internet usage influences the information ecology of individuals, thus shaping their world views. In our perspective, the terrorist emerges as part of a *digital counter-power* movement, a form of political violence, predominantly shaped by the information ecology of the Internet as an alternative voice to mainstream worldviews.

4.4.4.3 Order Parameter: Digital Terrorism Enactment

The meta-synthesis, under the first order theme of order parameter (Table 4-2), captured three dominant concepts of *dominant ideology* (philosophy, root causes), *policies* and *open models of information sharing* (Collaboration, Sharing Economy and Open Technology Platforms). The second order theme is linked to the notion of *transformation* (under CATWOE). From the methodological perspective of SSM, the

notion of Transformation focuses on the purposeful activities undertaken by the actors within a particular ecology with the aim of solving a problem (Checkland & Scholes, 1990). From the context of terrorism and counter-terrorism networks, transformation is viewed as the quality and nature of interactions of the multiple stakeholders, which are ‘structured’ by the *Digital Information Ecosystem* (DIE) of these stakeholders (Figure 4-2). The first order analysis based on the theory of synergetics (Table 4-2) ‘teased’ out the themes of *dominant ideology* (philosophy, root causes); *policies* and *open models of information sharing* (collaboration, sharing economy, open technology platforms). The second order analysis linked to the *transformation* process captured themes related to *policy, strategy, communication, frameworks, analysis, content, activities, technologies* and *data*. The commonality of the themes is stark, and while the previous Control Parameter (linked to the metaphor) of DIE was seen as a legitimization process in which the notion of *digital counter-power* is used to rationalize terrorism as an alternative form of political violence; the Order Parameter themes appear to capture the mobilization activities of terrorism (and counterterrorism). From one aspect, the emergence of digital counter-power as a control parameter explicates the ‘root causes’ of terrorism that results in different terrorism genres at the microscopic level of the analytical framework; while the second aspect of the emergence of alternative ‘worldviews’ that structures order parameter of digital terrorism enactment. It is this latter perspective that envisions the emergence of terrorism and counter-terrorism through various transformation activities objectified in dominant terrorism ideologies, policies and strategies.

From the context of this study, we employ a sociomateriality approach to untangle the meanings associated with the order parameter that we refer to as *digital terrorism enactment*. That the objectification of dominant terrorism ideologies, policies and strategies unfolds through the dynamic process of *enactment* of a set of activities - through social material routines and practices that meld digital artifacts and their capabilities with human actors and institutions (Gaskin, Berente, Lyytinen, & Yoo, 2014; Nambisan, 2017) that leads to individual and collective terrorism and counter-terrorism activities. The implication of employing the *enactment* perspective is that the admixture of digital artifacts and their capabilities with the human actors foments the dynamic emergence of terrorism and counter-terrorism activities underpinned by dominant ideologies, policies, strategies, etc. Therefore, the emphasis

of the order parameter of the *digital terrorism enactment* is in how terrorism and counter-terrorism plays out in reality.

4.4.4.4 *System Constraints: Digital Capability*

The view of terrorism ecologies as a self-organizing process also calls for assessing both internal and external constraints, a key feature of the analytical framework used in this study. Lienen, Geiger, Kriedel and Wagner (2016) claim that external constraints have a regulative effect on the behaviour of microscopic system elements (could be individuals or collectives) within the ecology of terrorism. In addition to the external system constraints, there are internal constraints, which are mainly based on the order parameters and macroscopic patterns that have been constructed in the past. The internal constraints are able to influence the functionality and interdependence of the system elements and set the system framework (Lienen et al., 2016). From the analysis above, we view the influence of the external and internal system constraints as instrumental in regulating, constraining or enabling the “*digital capability*” in relation to the microscopic elements. Under the CATWOE analysis, we liken the constraining nature of the various external and internal systems to “owners”, considered by Checkland and Scholes (1990) as those with the power to either stop or allow the transformations to take place. The role of digital technologies in the CATWOE analysis points to the visible role of the relational view of power (Doolin & Mcleod, 2012) of the digital artifacts, enabling or constraining the digital capabilities of actors and customers within the terrorism ecology. The second order thematic analysis brought to the fore the institutionalized nature of “*digital capabilities*”, by elevating the themes of ‘*institutional rivalry*’ and ‘*organizational perspectives*’ (Norms & Values, Roles & Responsibilities), and how they constrain the actions of terrorists and counter-terrorism agencies captured at the microscopic level of the theory of synergetics.

The explanatory lens of ‘*institutional rivalry*’ and ‘*organizational processes*’ in the second order themes not only points to the lack of alacrity for collaboration amongst counter-terrorism agencies; but also masks the differences in the maturity of their “*digital capabilities*” to combat terrorism. The differentiated digital capabilities of counter-terrorism agencies allow, on one hand, a category of these agencies to be efficient in responding to terrorism incidents because they have developed the critical infrastructure, weaponization of information and targeted social media messaging

(Omand, 2018). On the other hand, institutional separation in the security sector is deeply entrenched, and is linked to the separation of roles, responsibilities and (digital) resource endowments, which further foments institutional competition (Campana & Légaré, 2010). The same institutional and organizational processes are involved in the competition, institutional rivalry and organizational processes of collectives that foment terrorism globally. The influence of the level of “*digital capability*” acts to enslave the various organizing forms (individual, collectives) that act at the microscopic level of the terrorism and counter-terrorism networks.

4.4.4.5 System Elements: Digital Enslavement

The theory of synergetics envisages a dominant order parameter emerging from competing order parameters to ‘enslave’ systems elements (Figure 4-2) at the microscopic level. For instance, the analysis above, through the process of enactment, espoused the influence of dominant ideologies, strategies and policies that provides traction to how active and visible a certain brand of terrorism and counter-terrorism transformation occurs. As a dominant order parameter emerges, a ‘slaving’ process entrenches systems elements, in which individuals and collectives (security agencies, terrorism cells), which are enabled and constrained by digital capabilities, results in a general scenario which gives rise to local terrorism and counter-terrorism activities.

In our meta-synthesis, we give prominence to “*digital enslavement*”, as the ‘slaving’ process anchored on the role of digital technologies. The first order thematic analysis linked to CATWOE emphasized the role of digital technologies in this process. Two aspects of the system elements are linked to the CATWOE analysis, the first is the customers (C) or the beneficiaries or victims affected by the system under consideration (Checkland & Scholes, 1990). Under this category, the counter-terrorism and terrorism individuals and entities are the customers. In the second category, CATWOE analysis identified various digital technologies actors (A) in which these technologies are the principal agents in the terrorism ecology (Bertram, 2016). The second order analysis, based on the theory of synergetics, points to two organizing principles of “*digital enslavement*”: *collective intelligence* and *open governance models*.

Collective Intelligence (CI), in the manner emerging from the analysis above, recognize consensus seeking among self-interested individuals to collectively solve/address different tasks (Massari, Giannoccaro, & Carbone, 2019). The use of CI

needs to be seen from two perspectives:- how terrorists, while sometimes acting as ‘lone wolves’, are influenced both overtly and covertly by digital platforms; and how, due to distrust and agency rivalry, counter-terrorism agencies fail in addressing the terrorism problem. The first part of the argument brings to the fore how digital technologies augment human capacity of individuals, which has the effect of collectively harnessing the CI of terrorists throughout the world (Jaeger & Dunn, 2019). The manner of use of CI applicable to terrorists is linked to their ability to make use of digital technologies to make better sense of their environment in a way that has seen the proliferation of various terrorism genres. The terrorist is no longer isolated, lone and unintelligent; but acts, urged forward through the CI of a digitally-enabled global crowd of terrorists. The second part of the argument is linked to the ineffectiveness of counter-terrorism agencies in using CI to tackle terrorism. The earlier analysis of the ineffectiveness of counter-terrorism response to acts of terrorism was linked to institutional rivalry and a constraining organizational perspective related to ownership of specific roles, values, norms and responsibilities. Despite global recognition that the effectiveness CI rests on the principles of *open governance* (collaboration, transparency, and participation), the practice amongst counter-terrorism agencies contradicts this ethos. For instance D’Souza (2019), proffers that with the ascendancy of decentralized terrorism, a more holistic approach to counter-terrorism is imperative i.e. combining military action, CI, de-radicalization and more inclusive governance practices.

Various governments have also advanced the notion of ‘collective securitization’, where cooperating states and regions develop joint counter-terrorism policies and response, such as between the EU and USA (Kaunert & Léonard, 2019); West Africa (Akanji, 2019), and East Africa (Bailey, 2019). Despite these efforts, critics claim that ‘collective securitization’ remain at the level of regulative and legislative rationality, and has failed (Ruzicka, 2019); yet the increased digitalization of the society proffers better means of realizing *open governance* and *CI*.

4.5 SUMMARY

From the meta-synthesis above, two tentative insights are possible. The first relates to the conceptual ambiguity of the structure of terrorism. The premise of the analytical theorizing undertaken was premised on the sociomaterial and ‘wicked’ nature of the problem of terrorism, which allowed a systems perspective of self-

organization to be used to undergird the analysis. From the synthesis, viewing terrorism as separate from the broader technologization of society is not only imprudent, but constrains society's ability to organize and counter terrorism effectively. Rather, viewing terrorism as a self-organized system as a digitalized ecology, comprising of a complex web of interacting agents, users and technologies allows for better conceptualization. The synthesis above identified five key processes/sub-systems interacting within the digitalized terrorism ecology: *Open Digital Infrastructure (ODI)*, *Digital Information Ecosystem (DIE)*, *Digital Terrorism Enactment (DTE)*, *Digital Capability* and *Digital Enslavement*. These five subsystems act to define the sociomaterial nature of the terrorism ecology, which influences both the emergence of terrorism and counter-terrorism response.

The conceptualization adopted from the synthesis views the digitalized terrorism ecology as comprising a stable but complex coexistence of several networks/processes, centred on an Open Digital Infrastructure (ODI), typified by a 'sharing economy'. The 'sharing economy', whose discourse has predominantly been within business disciplines, is also at play within digital platforms that foment terrorism (Teigland, Holmberg, & Felländer, 2019). It is this 'sharing economy', as an affordance of the ODI, that inspires the emergence of a Digital Information Ecology (DIE) for individuals and collectives, which acts to empower them to consider and appropriate, previously unknown 'worldviews' through the use of 'digital counter-power'. The emergence of dominant 'worldviews' through the process of 'enactment', then structures and 'enslaves' the emergence of various terrorism and counter-terrorism genres. While the prevailing view is that there is an increase in 'lone-actor terrorists' acts (Sela-Shayovitz & Dayan, 2019), the influence of the digitalized terrorism ecology on individuals and collectives over time need to be the prime foundation for understanding terrorism.

Nevertheless, this Chapter has presented terrorism structuring in the digital age. The theory of synergetics has been used following soft systems methodology and a meta-synthesis approach. The findings of this Chapter have shown the complex nature of the terrorism problem due to the presence, access and availability of digital technologies in the *modern* age. In the next Chapter, the results from the survey on the factors influencing attainment of optimal collaborative decision making amongst counter-terrorism organizations is given.

Chapter 5: Cultivating Optimal Collaborative Decision Making in Counter-Terrorism Contexts

5.1 INTRODUCTION

In Chapter 3, the research methodology adopted in this study was discussed in detail. In order to identify the factors influencing collaboration in decision making amongst stakeholders involved in counter-terrorism (*research question 2*), a cross-sectional survey was employed. The findings of the survey are presented in this Chapter³⁴. The survey had two main constructs: CDM enablers (independent variables) and optimal CDM (dependent variable).

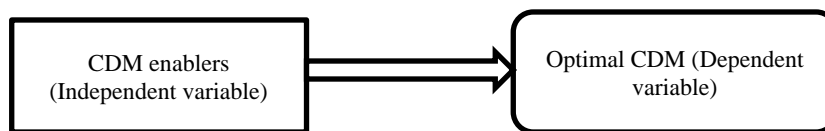


Figure 5-1: Hypothesized relationships

CDM enablers were hypothesised in the study to influence Optimal Collaborative Decision Making (OCDM) (see Figure 5-1). The argument in the study was that OCDM can be influenced by CDM enablers. In order to address the envisage objective, an empirical assessment based on Partial Least Squares Structural Equation Modelling (PLS-SEM) was used. Reliability analysis as well as exploratory factor analysis was also conducted.

The remainder of the Chapter is organised as follows: Instrument development is described in Section 5.2, followed by a discussion on population and sample (Section 5.3). Reliability and validity results are provided in Section 5.4. Thereafter in Section 5.5 exploratory factor analysis results are presented. PLS-SEM results are

³ Conference version of the chapter published as: Ochara, N. M., & Odhiambo, N. A. (2019, April). Investigating Determinants of Optimal Collaborative Decision Making. In XXII-th Russian conference "Engineering companies and knowledge management" (KM & SP - 2019)

⁴ Odhiambo, N. A., Ochara, N. M., & Kadyamatimba, A. (2019). Cultivating Optimal Collaborative Decision Making in Counterterrorism Contexts: An Empirical Investigation. *International Journal of Public Administration*, 1-13..

presented in Section 5.6, followed by a discussion of the findings of PLS-SEM results in Section 5.7, and a conclusion in section 5.8.

5.2 INSTRUMENT DEVELOPMENT

To develop a pragmatic instrument that captured the necessary information required for answering research question 2, the systematic procedure proposed by (MacKenzie, Podsakoff, & Podsakoff, 2011) was used relying on institutional theory. At the end of the process there were six constructs: Organizational Form (OF); Technical Infrastructure/Inter-operability (TI); Group/Departmental Relationships (GDR); Organizational Co-operation (OC) and Information and Knowledge Sharing (IKS).

Each construct was measured using multiple items in order to capture the underlying theoretical dimensions effectively. All the measurements were based on a 7-point Likert scale where: 1- strongly disagree, 2-disagree, 3- somewhat disagree, 4- neutral, 5- somewhat agree, 6- agree, 7- strongly agree. The seven-point interval scale was used to give respondents wider response options that suit their utmost judgement (Hoque et al., 2018). In total, there were 42 items used to investigate these constructs. Table 5-1 lists the constructs their respective indicators (items).

Table 5-1: Constructs and their respective indicators

Construct	Indicators	Construct	Indicators
Information and Knowledge Sharing (IKS)	<ol style="list-style-type: none"> 1. Information sharing 2. Information sharing policy 3. Awareness of the information sharing policies 4. Accountability 5. Respect 	Optimal Collaborative Decision Making (OCDM)	<ol style="list-style-type: none"> 1. Consensus 2. Social Interactions 3. Competence 4. Flexibility 5. Transparency
Organizational Form (OF)	<ol style="list-style-type: none"> 1. Organizational structure 2. Team work 3. Member's roles 4. Inter-agency roles 5. Ethical standards 6. Departmental interactions 7. Decentralization 8. Inter-departmental interactions 9. Organizational goals 	Organizational Co-operation (OC)	<ol style="list-style-type: none"> 1. Participation 2. Departmental participation 3. Conflict resolution 4. Collaboration and conflict resolution 5. Inter-departmental co-operation 6. Shared vision 7. Inter-departmental leadership + shared vision + CDM
Departmental/ Group Relationships (GDR)	<ol style="list-style-type: none"> 1. Communication frequency (communication flow) 2. Inter-departmental communication 3. Departmental believes and values 4. Mutual trust 5. Idea sharing (Inter-departmental) 6. Informal relationships and policy 7. Informal relationships and collaboration 8. Inter-departmental informal relationships 9. Open communication 	Technical Infrastructure and Inter-operability (TI)	<ol style="list-style-type: none"> 1. ICT 2. Reliable ICT 3. Expertise in ICT 4. Training 5. Inter-operability 6. Organizational integration 7. Service delivery

5.3 POPULATION, SAMPLE AND VALIDITY

Since the unit of analysis in this study was the organization, the sample used in the study consisted of respondents from the immigration department, the security department and the intelligence units. To ensure face and content validity, a group of fellow researchers went through the developed research instrument to check for errors in terms of structure, grammar, sentence construction and relevancy of the items to the constructs being measured. In addition, the survey was conducted in two phases. The first phase involved testing the developed instrument with a sample of 86 respondents. After which reliability analysis (Section 5.4) and Exploratory Factor Analysis (EFA) (Section 5.5) were conducted to determine the credibility of the developed research instrument. This first phase was a pilot study and was done to ensure construct validity in other words, if the instrument measured what it was intended to measure. The second phase involved collecting the actual data, which upon completion, resulted in a sample size of 176 respondents. Out of the 176 respondents, 72 were from the police department, 31 from the criminal investigation unit, 28 from the immigration department and 45 from counter-terrorism units. In terms of country representation, a majority were from Kenya (56%), followed by South Africa (32%) and Nigeria (12%).

5.4 RELIABILITY ANALYSIS RESULTS

According to Rovai, Baker and Ponton (2013), it is advisable to assess internal consistency (degree of homogeneity amongst the items). In this study, since the survey instrument was new and had not been used previously in any study, the internal consistency of the instrument was assessed using Cronbach's Alpha (see Table 5-2). This was done for data collected in Phase One. For all the six constructs, the Cronbach's Alpha values had a reliability value > 0.7 , which is acceptable according to George and Mallery (2003). The rule of thumb according to George and Mallery (2003), states that Cronbach's Alpha values > 0.9 - as excellent, > 0.8 - as good, > 0.7 - as acceptable, > 0.6 as questionable, > 0.5 as poor and < 0.5 as unacceptable. Upon completion of the reliability process, the 34 indicators (29 independent and 5 dependent) which remained were then subjected to Exploratory Factor Analysis (EFA).

Table 5-2: Reliability analysis results

Constructs	Cronbach's alpha	No of items
Information and knowledge sharing	0.8	6
Organizational form	0.9	7
Group/Departmental relationships	0.8	4
Organizational cooperation	0.7	5
Technical infrastructure and inter-operability	0.8	7
Optimal CDM	0.7	5

5.5 EXPLORATORY FACTOR ANALYSIS RESULTS

Exploratory Factor Analysis (EFA) and Principal Component Analysis (PCA) were employed as a factoring technique for two purposes: (i) to determine the factorial structure; and (ii) to reduce the number of variables to a smaller number of factors that could be used to best represent the interrelations among the set of variables. Prior to performing factor analysis, Kaiser-Meyer-Olkin test (KMO) and Bartlett's sphericity test were conducted to confirm whether the data was sufficient for factor analysis (Hair et al., 2006; Lorenzo-Seva, Timmerman, & Kiers, 2011). In the KMO test, the values vary from 0 to 1, whereby values greater than 0.7 are recommended as being desirable for applying EFA (Hair et al., 2006). A significant Bartlett's test ($p < 0.05$) indicates that sufficient correlation exists between the variables to continue with the analysis (Renault, Agumba, & Ansary, 2018).

Moreover, in order to decide on the factors to extract, as well as to determine the most appropriate component solution in the study, both Kaiser's Guttman Rule (K1 rule) and the screen plot were conducted. K1 rule advocates for the retention of factors with Eigen values of at least 1, whereas the screen plot considers only those factors that appear before the steep decline ends.

The factors retained in this study were based on Hair et al., (2006) who proposed the following rule of thumb for considering factor loadings: loadings > 0.3 - as significant, loadings > 0.4 - more important and loadings > 0.5 - very significant. While the items with loadings in more than one factor are only considered in the factor with a higher loading of the item.

5.5.1 CDM Enablers Results

This section presents the results of factor extraction, rotation, interpretation and discussion of the identified factors of CDM enablers.

5.5.1.1 Extraction Process

Table 5-3 gives a KMO measure of 0.704 which is above the recommended cut off value of 0.60 and a significant Bartlett's test ($p < 0.05$) (Renault et al., 2018). These results indicate that the factor model was appropriate; a confirmation that the factor analysis procedure was appropriate for this data.

Table 5-3: KMO and Bartlett's test results

Test	Value
KMO measure of Sampling Adequacy	0.704
Bartlett's Test of Sphericity Approx. Chi-Square	2002.023
Df	528.000
Significant	0.000

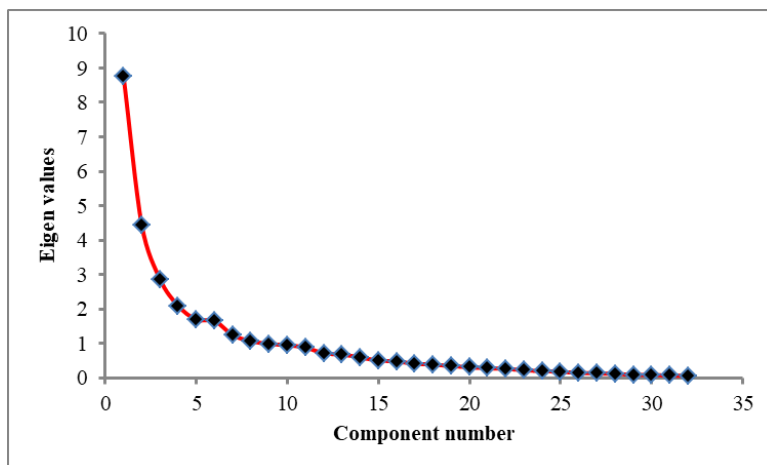
Table 5-4 presents the total variance explained, which is also an extraction process that helps with the reduction of measurement items into manageable numbers for further analysis. As shown in Table 5-4, 8 factors had Eigen values greater than 1, accounting for approximately 72% of the variance in the collected data.

Table 5-4: Total variance explained

Initial Eigenvalues			Rotation Sums of Squared Loadings			
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.766	26.565	26.565	5.845	17.713	17.713
2	4.440	13.454	40.019	4.094	12.407	30.120
3	2.871	8.700	48.719	3.327	10.407	40.202
4	2.095	6.348	55.067	2.574	7.800	48.002
5	1.696	5.138	60.205	2.517	7.628	55.630
6	1.657	5.022	65.227	2.182	6.612	62.242
7	1.243	3.766	68.993	1.706	5.171	67.413
8	1.071	3.244	72.237	1.592	4.824	72.237

Figure 5-2 shows a screen plot for the 29 measurement items as a confirmation to examine the 8 factors retained.

Figure 5-2: A screen plot of CDM enablers



5.5.1.2 Interpretation and Discussions

Table 5-5 presents the factors extracted the items per the factor and their respective factor loadings. As mentioned, only the measurement items with factor loadings > 0.4 were retained as per (Hair et al., 2006). Factor 7 and 8 had one measurement item loading and were dropped since they failed to provide minimum coverage of the construct theoretical domain (Hair, 2010, p.676). This therefore resulted into a six-factor model consisting of 29 measurement items.

Based on the items which loaded on each factor, factor names were identified. Since every organization achieves its goals through its employees, the items in factor 1 were inclined towards the success of an organization in attaining OCDM hence, the label *organizational goals*. Similarly, using the same factor nomenclature convention, the other factors were named as follows: The items in factor 2 were more inclined towards *Information and Communication Technology (ICT)* and hence its name. The items in factor 3 were more inclined towards *informal relationships*, which have been shown in literature to influence inter and intra organizational CDM needed for OCDM. The items in factors 4 and 5 were inclined towards how *organizational co-operation* and *organizational culture* can influence the attainment of OCDM, and hence their naming. Within the context of terrorism and counter-terrorism, there is need for information sharing in order to attain OCDM. This, to a great extent, can lead to effective response during terrorism events and hence, the name, *information sharing*, is based on the inclination of items in factor 6.

Table 5-5: Rotated component matrix for CDM enablers

Items	Factor					
	1	2	3	4	5	6
Mutual trust	0.857					
Values and beliefs	0.806					
Idea sharing	0.788					
Respect	0.686					
Intra-departmental communication frequency	0.650					
Communication frequency	0.627					
Ethical standards	0.603					
Inter-agency roles	0.572					
Members awareness of each other's roles	0.505					
Decentralization	0.515					
Intra-formal interactions	0.499					
Service delivery		0.778				
ICT Integration		0.751				
Inter-operability		0.717				
Training		0.668				
ICT		0.640				
Reliable ICT		0.483				
Inter-departmental relationships			0.851			
Intra-informal relationships			0.828			
Informal relationships			0.800			
Departmental conflict resolution				0.816		
Conflict resolution				0.761		
Inter-departmental co-operation				0.460		
Organizational structure					0.811	
Team work					0.599	
Accountability					0.531	
Information sharing policy						0.789
Members awareness of IS policy						0.612
Information sharing						0.521

5.5.2 Optimal CDM Results

The results for factor rotation and extraction and interpretation for optimal CDM are presented. The data presented in Table 5-6 reveals the KMO measure (0.766) and a significant Bartlett's test of sphericity ($p < 0.05$). These tests confirm that the factor analysis procedure was also appropriate for the data (Hair et al., 2006; Pallant, 2013).

Table 5-6: KMO and Bartlett's test for optimal CDM

Test	Value
KMO measure of Sampling Adequacy	0.745
Bartlett's Test of Sphericity Approx. Chi-Square	112.128
Df	10
Significant	0.000

The factor analysis procedure conducted on the five measurement items; *consensus, social interactions, competence, flexibility and transparency* for optimal CDM resulted into a retention of only 1 significant factor and therefore it could not be rotated (Figure 5-3). This was an indication that all of the measurement items fitted into a single theoretical construct. The extracted factor had an Eigen value of 2.583 and the total variance explained accounted for approximately 51.67%.

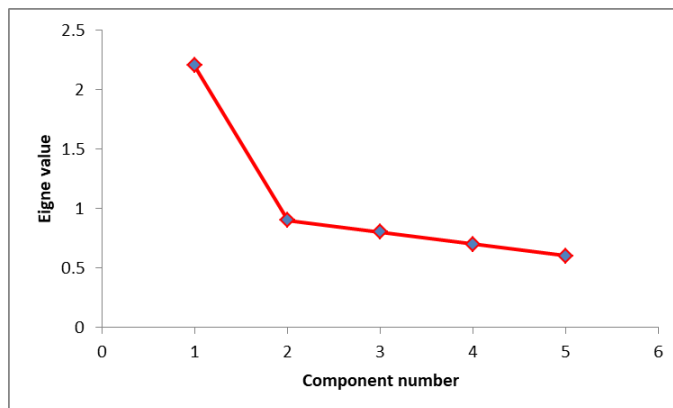


Figure 5-3: A screen plot for optimal CDM

5.6 PLS-SEM RESULTS

To interpret and examine PLS-SEM results, a two-step approach (measurement and structural model evaluation), as recommended by Ali et al., (2018) and Chin, (2010), was employed. The analysis was done using the *plspm* package (Sánchez & Trinchera, 2015) in R statistical software with 176 respondents. In order to investigate the relationships between the constructs, namely, Organizational Form (OF), Technical Infrastructure/Inter-operability (TI), Group/Departmental Relationships (GDR), Organizational Co-operation (OC) and Information and Knowledge Sharing (IKS) and Optimal Collaborative Decision Making (OCDM), a theoretical model was

proposed relying on the literature on CDM as well as institutional theory (Chapter 2) (see Figure 5-4), and were tested using the following hypotheses:

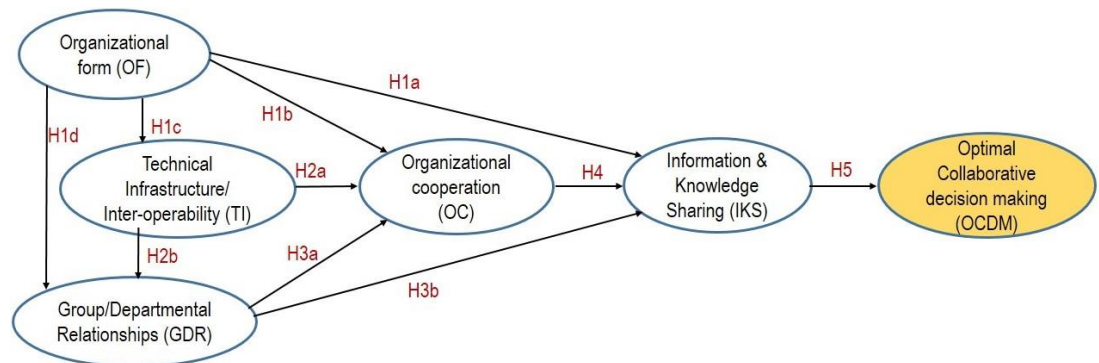


Figure 5-4: Proposed theoretical model

H1a: OF has an effect on IKS.

H1b: OF has an effect on OC.

H1c: OF has an effect on TI.

H1d: OF has an effect on GDR.

H2a: TI has an effect on OC.

H2b: TI has an effect on GDR.

H3a: GDR has an effect on OC.

H3b: GDR has an effect on IKS.

H4: OC has an effect on IKS.

H5: IKS is positively related to OCDM.

5.6.1 Measurement Model Evaluation

The assessment at this stage is based on whether the constructs are measured reflectively or formatively. In this study, the constructs were measured formatively and therefore, the measurement model evaluation process involved assessing for multicollinearity, validity and indicator weights (Abbasi, Ting, & Hlavacs, 2017).

5.6.1.1 Multicollinearity

Multicollinearity check was computed to establish the internal reliability consistency in the formative constructs. This was done to ensure that the indicators are not highly correlated. Hair et al., (2014) suggests that multicollinearity is of concern in a study if the Variance Inflation Factor (VIF) values are greater than 5. Thus, based on Hair et al., (2014), 38 indicators were retained for further analysis (see Table 5-7).

Table 5-7: Multicollinearity check

Construct and Indicators	VIF Values	Construct and Indicators	VIF Values
Information and Knowledge Sharing		Organizational Co-operation	
Information sharing (IS) (IKS1)	3.6228	Adequate participation (OC1)	2.7520
Information sharing policy (IKS2)	3.6271	Inter/intra departmental participation (OC2)	3.3117
Members awareness of IS policy (IKS3)	4.3139	Department conflict resolution (OC3)	3.9793
Staffing levels (IKS4)	2.1811	Inter/Intra departmental conflict resolution (OC4)	4.9790
Accountability (IKS5)	2.1823	Shared vision (OC5)	2.6095
Respect (IKS6)	4.4020	Inter-departmental leadership and shared vision (OC6)	4.4723
Organizational Form		Technical Infrastructure and Inter-operability	
Organizational structure (OF1)	4.2989	Information and communication technology (TI1)	4.6980
Organizational culture (OF2)	4.9215	Reliable ICT (TI2)	4.2966
Organizational governance (OF3)	2.8725	ICT expertise (TI3)	3.7930
Inter-agency roles (OF4)	3.7416	Inter-operability (TI4)	2.7978
Formal interactions (OF5)	3.4647	ICT departmental integration (TI5)	4.2531
Decentralization (OF6)	3.1395		
Inter-agency interactions (OF7)	2.4266		
Organizational goals (OF8)	3.2456		
Group/Departmental Relationships (Informal)			
Communication frequency (GDR1)	3.1661		
Inter-departmental communications (GDR2)	4.1207		
Values and beliefs and mutual trust (GDR3)	3.4411		
Mutual trust and Idea sharing (GDR4)	4.5274		
Mutual trust and inter/intra departments (GDR5)	4.0709		
Informal relationships and policy (GDR6)	4.8695		
Informal relationships and departmental clusters (GDR8)	4.5663		
Open communication (GDR9)	2.6446		

5.6.1.2 Indicator Weights and Validity

In a formative measurement model, indicator weights assist in determining construct validity. According to Marín-García, Pérez-Peñalver and Watts (2013), indicator weights that are statistically significant, and which exceed 0.1 show that the respective indicators are relevant to a particular construct. Thus, to determine the significance of the indicators to their respective constructs, a bootstrap procedure with 500 samples was undertaken.

Table 5-8, illustrates the relevant formative indicators in terms of their weights and statistical significance. In total, there were 9 formative indicators for the construct of OF, of which only 4 indicators had weights > 0.1 and 3 were statistically significant. Under the TI construct, there were 7 indicators, out of which only 3 had weights > 0.1 and 2 were statistically significant. For GDR, 4 out of 9 indicators had weights > 0.1 and 2 were statistically significant. Regarding the OC construct, 4 out of 6 indicators had weights > 0.1 and 2 were statistically significant. The IKS construct had 4 of its 6 indicators with weights > 0.1 and only 3 being statistically significant. While, in the OCDM construct, only 1 of its 5 indicators had a weight < 0.1 with 2 being statistically significant.

There is no unanimity on how non-significant indicators are to be treated in formative measurement models (Cenfetelli & Bassellier, 2009; Diamantopoulos & Winklhofer, 2001). Diamantopoulos and Winklhofer (2001) propose the elimination of non-significant indicators in a study, arguing that in doing so there is a high probability of getting more significant paths. On the contrary, Diamantopoulos and Siguaw (2006) claim that indicator elimination in a formative measurement model maybe tricky as it can affect content validity and also interfere with the conceptual meaning of the constructs (Coltman, Devinney, Midgley, & Venaik, 2008). Hence, since conceptual meaning is more influential on the constructs (Hair, Ringle, & Sarstedt, 2011) as opposed to statistical relevance, in this study, all the formative indicators (significant and non-significant) were retained for further analysis. In order to establish content validity of the formative construct measures, a review of literature as recommended by Petter, Straub and Rai (2007), was conducted.

Table 5-8: PLS analysis, weights and bootstrapping values

Construct	Indicator	Weight	Mean. Boot	Std Error	Perc.025	Perc.0975
IKS	Information sharing (IS)	0.18974	0.188420775	0.1608228	0.115640227	0.552917796
	Members awareness of IS policy	0.59056	0.568704628	0.1899326	0.228981413	0.916240010
	Staffing levels	0.18135	0.170530825	0.1195746	-0.105370347	0.391329804
	Respect	0.36673	0.343879563	0.1623441	-0.036732959	0.615429088
OF	Organizational culture	0.41506	0.328009280	0.1790607	-0.055816929	0.650596886
	Formal interactions	0.30244	0.297715844	0.1875825	0.048117655	0.661704468
	Inter-agency interactions	0.21238	0.185903732	0.1620233	0.125823892	0.513784918
	Organizational goals	0.60533	0.510643891	0.1572818	0.204962642	0.764746717
GDR	Communication frequency	0.38533	0.342583243	0.1539370	0.027145375	0.608354414
	Inter-departmental communication	0.46085	0.460845688	0.390816858	0.1356667	0.588856400
	Informal relationships and policy	0.25519	0.241137828	0.2381606	0.168058353	0.706204837
	Informal relationships and departmental clusters	0.23466	0.188281263	0.1944941	-0.257328343	0.501709554
OC	Adequacy participation	0.45508	0.410016949	0.2332223	0.006568275	0.867596385
	Inter-departmental participation	0.13365	0.092592793	0.2716311	0.569397776	0.597577972
	Inter-departmental leadership and shared vision	0.72291	0.649888210	0.2123858	0.103633048	0.962440433
TI	ICT	0.28088	0.270324972	0.3059959	0.306313427	0.823743920
	ICT Inter-operability	0.28088	0.493662600	0.3215560	-0.239168449	1.046373488
	ICT integration	0.48804	0.385490140	0.2879696	0.279662480	0.843641690
OCDM	Consensus	0.10284	0.108991505	0.2183241	-0.249831323	0.561292647
	Collective intelligence	0.59142	0.503862226	0.2371637	0.025098464	0.839247043
	Competence	0.38076	0.400004491	0.2290622	0.070671406	0.819031706
	Flexibility and openness	0.50809	0.438277865	0.2592468	0.178387504	0.801693768

5.6.2 Structural Model Evaluation

The assessment of the structural model involves the predictability of the model and the relationships between the constructs (Rezaei, 2015).

5.6.2.1 Explanatory Power of the Model

In PLS-SEM, the prediction ability of the structural model is evaluated using coefficient of determination (R^2) value of the endogenous variables (Panahifar, Byrne, Salam, & Heavey, 2018; Ravand & Baghaei, 2016). R^2 values range from 0 to 1, in which higher values imply a higher degree in model predictive accuracy. Sánchez, Trinchera and Russolillo (2015) suggest that R^2 values > 0.6 indicate high model predictive ability, 0.3 to 0.6 indicate a moderate model predictive ability and < 0.3 indicate low model predictive ability.

As presented in Table 5-9, the R^2 values for the all constructs indicate that the proposed theoretical model (Figure 5-4) had a moderate model predictive ability according to the formalism of Sánchez, Trinchera and Russolillo (2015).

Table 5-9: R^2 values of the endogenous variables

Variable	R^2 values
TI	0.375
GDR	0.497
IKS	0.585
OC	0.395
OCDM	0.425

5.6.2.2 Path Coefficients

To assess the significance and relevance of the relationships between constructs, path coefficients were used. As depicted in Table 5-10, the path coefficients for the structural model were all found to be statistically significant ($p < 0.05$), except for the hypothesis, **H1b**.

Table 5-10: Path coefficients results

Hypothesis	Path	Path coefficient	Std.error	t-value	P-value
H1a	OF -> IKS	0.371	0.0665	5.58	9.14×10^{-47}
H1b	OF -> OC	-0.155	0.0810	-1.92	5.65×10^{-02}
H1c	OF -> IT	0.418	0.0689	6.07	7.78×10^{-09}
H1d	OF-> GDR	0.572	0.0593	9.65	6.80×10^{-18}
H2a	TI -> OC	0.372	0.0682	5.45	1.75×10^{-07}
H2b	TI -> GDR	0.237	0.0593	4.00	9.41×10^{-05}
H3a	GDR-> OC	0.462	0.0837	5.53	1.20×10^{-07}
H3b	GDR->IKS	0.425	0.0748	5.68	5.68×10^{-08}
H4	OC-> IKS	0.738	0.0583	1.27	2.07×10^{-01}
H5	IKS->OCDM	0.474	0.0667	7.11	2.9×10^{-11}

5.6.2.3 Hypothesis Validation

As earlier mentioned, PLS-SEM is a non-parametric procedure and therefore, in order to determine the significance level of the path coefficients and to confirm the robustness of the findings, a re-sampling bootstrap procedure with 500 re-samples was computed (Hair et al., 2014). Table 5-11, indicates that, at $\alpha = 0.05$, hypotheses **H1a, H1c, H1d, H2a, H2b, H3a, H3b** and **H5** are supported according to (Aminu & Mahmood 2015; Hair et al., 2014; Ravand & Baghaei, 2016).

Table 5-11: Path coefficients and bootstrap standard errors

Hypothesis	Path	Original	Mean.Boot	Std.Error	perc.025	perc.975	Decision
H1a	OF -> IKS	0.37093708	0.3605491	0.12391635	0.07022120	0.5696465	Supported
H1b	OF -> OC	-0.15546688	-0.0463651	0.13477315	-0.28833640	0.2531490	Not Supported
H1c	OF -> TI	0.41805907	0.5128265	0.06792523	0.39096456	0.6526835	Supported
H1d	OF->GDR	0.57240483	0.56659982	0.07991671	0.38985766	0.7038643	Supported
H2a	TI -> OC	0.37167032	0.3193018	0.10795646	0.09792977	0.4994344	Supported
H2b	TI -> GDR	0.23725556	0.2585430	0.08970218	0.08410975	0.4412457	Supported
H3a	GDR-> OC	0.46232848	0.4271034	0.15130894	0.10106006	0.7054064	Supported
H3b	GDR -> IKS	0.42465964	0.3937698	0.11750500	0.15819071	0.6028447	Supported
H4	OC -> IKS	0.07379576	0.1015917	0.08841260	-0.05047060	0.3130275	Not Supported
H5	IKS-> OCDM	0.47443104	0.5032837	0.05310872	0.40252584	0.6064400	Supported

5.7 DISCUSSIONS OF THE FINDINGS FROM THE PROPOSED THEORETICAL MODEL

The aim of this Chapter was to empirically assess the impact of CDM enablers (OF, OC, IKS, GDR and TI) on OCDM. Of the ten hypotheses (Table 5-11), only eight: H1a, H1c, H1d, H2a, H2b, H3a, H3b and H5, were supported and are discussed as follows:

Organizational form (e.g. culture, structure, governance) has an effect on information and knowledge sharing, **H1a**, an observation consistent with that of Kim and Lee (2005). Where, organizational form was found to exert significant influence on information and knowledge sharing amongst employees. Additionally, organization form has also been found to impact inter-organizational information and knowledge sharing (Gil-Garcia & Sayogo, 2016; Sayogo & Gil-Garcia, 2014). According to Stoddart (2001), information and knowledge sharing in any organization occurs only if the culture allows and hence, organization form impacts inter/intra organizational information and knowledge sharing. Further, culture (Cronin, 2001), structure (Walczak, 2005) and leadership (Bircham-Connolly, Corner, & Bowden, 2005) amongst others have also been linked to organizational knowledge sharing behaviour (Fullwood & Rowley, 2017).

Organizational form was found not to have an effect on organizational co-operation, **H1b**. This is in contradiction to (Chatman & Barsade, 1995; Smith, Carroll, & Ashford, 1995), who observed that organizational form has a significant impact on organizational co-operation. An organization's culture can either enhance or hinder inter/intra organizational co-operation. This is because an organization's culture can either be individualistic or collectivistic: in an individualistic culture, an employee is rewarded based on his/her own individual efforts in the attainment of organizational goals, while in a collectivistic culture; employees are rewarded for their joint contribution to organizational accomplishments. Thus, in a collectivistic culture, group work amongst and between the employees is promoted unlike in the individualistic cultures. In addition, cultural differences in legal systems and relationships between agencies and governments also influence organizational co-operation (Smith et al., 1995).

Organizational form was found to have an effect on technical infrastructure and inter-operability, **H1c**, a finding concurring with that of Pardo et al., (2008b). In the

study, the existence of a direct relationship between co-operate governance and IT governance in organization was brought to the fore. Wu, Straub and Liang (2015) also showed that IT governance in an organization contributes to the effective use of IT within the organization and therefore, in order to implement IT governance in an organization, a set of IT governance mechanisms is required to encourage the congruence with the organizational mission, strategy, values, norms and culture (Ali & Green, 2012; Herz, Hamel, Uebernickel, & Brenner, 2012; Wu et al., 2015). This is an indication that organizational form has an effect on technical infrastructure and inter-operability.

The findings in this study also showed that organizational form influences group/departmental relationships, **H1d**. While past practice dictated that good employee social interactions took place between 0800hrs to 1700hrs (Reich & Hershcovis, 2011), modernization and advancements in ICT has negated this notion. This is because ICT has transformed the culture in some organizations to a point that employees rarely meet face-to-face, even though they still work between 0800hrs to 1700hrs. This change in an organization's culture has an impact on workplace informal relationships (Reich & Hershcovis, 2011). In addition, organizational norms such as mixed cultures (e.g. African, Indian, White, and Chinese) and leadership styles (e.g. relational, transformational) may also have an effect on interpersonal relations. The leadership style might be good in facilitating employees' (inter-personal) interactions in the work place (Dutton, 2003; Heaphy & Dutton, 2008). Similarly, this can also promote effective and healthy conflict resolutions at the work place which is good for sustaining and repairing interpersonal interactions (Dutton, 2003). Equally, a good leadership style in the workplace enhances the development of trust, team cohesion and friendliness amongst employees all of which influence collaboration (Arnold, Barling, & Kelloway, 2001; Bass & Riggio, 2006). Thus, organizational form can influence group/departmental relationships.

In relation to **H2a**, the study findings illustrated that technical infrastructure and inter-operability influences organizational co-operation. Prior research confirms this finding. Chae, Yen and Sheu (2005) have linked the potential of ICT to its ability to improve processing power of organizations and thereby enables/support efficient intra/inter-agency co-operation. ICT also has the power of enabling electronic co-operation using distributed CAD/CAM systems and other collaborative systems (Grover, Teng, & Fiedler, 2002). The socio-materiality aspect of the society with its

affordances in terms of ICT infrastructure (e.g. Internet accessibility) can also be a facilitator of co-operative capabilities without the cost of risk of ownership (López & Skarmeta, 2003). In addition, ICT use in an organization can assist in enforcing procedures and rules when it comes to tasks requiring co-operative activities (Grover et al., 2002). Hence, ICT use enhances inter and intra organizational co-operation activities.

In support of **H2b**, the findings in this study indicate that technical infrastructure and inter-operability has an effect on group/departmental relationships. This reaffirms the assertion that with the presence and access of IT, organizations can build relationships and exchange real time information with one another (business partners) and their respective suppliers and customers (Apulu & Latham, 2011). In addition, the presence and use of enterprise social media platforms in today's organizations not only act as a channel for communication flow, but also a platform for social interactions (Leonardi, Huysman, & Steinfield, 2013). Unlike traditional physical offices in organizations, these current communication channels are digital and therefore, employee participation is voluntary and can occur at any time. Further, advancements in ICT have triggered unprecedented and dramatic changes in social interactions and exchanges within and beyond the organizational boundaries (van Osch, Steinfield, & Balogh, 2015). Hence, IT influences group and departmental relationships.

H3a was in agreement with Foley (2016) that, group/departmental relationships influences organizational co-operation. This is because, through informal relationships trust is built, which in turn, influences inter or intra agency co-operations. Trust and co-operative relations in the workplace are shown as by-products of informal relationships which are good for promoting co-operation practices (Chen et al., 2013; Dotan, 2007). Thus, informal relationships influences inter and intra organizational co-operations.

Hypothesis **H3b**, which focused on the effect of group/departmental relationships on information and knowledge sharing, was also supported in this study. This is in accordance to the findings of (Chenet, Dagger, & O'Sullivan, 2010; Martins et al., 2017; Van Vuuren et al., 2012) where, continuity of relationships over time was shown to motivate collaboration between organizations in terms of information and knowledge sharing. In addition, Klein's et al., (2018) also indicate that teamwork and information sharing are greatly improved when organizations are co-located and

informal relationships are established. This is because of the enhanced trust between the organizations. Poor or no (informal) relationships results in no active engagement amongst organizations with the information and those that require the information (Carter, 2015). Nevertheless, in practice, security information sharing (inter or intra) is usually accomplished via *ad hoc* and informal relationships (Skopik, Settanni, & Fiedler, 2016). In other words, based on the discussion above, it is evident that informal relationships affect information and knowledge sharing.

The influence of organizational co-operation on information and knowledge sharing, **H4**, was not supported in this study. This finding concurs with that of Groenleer (2009) who highlighted that there existed poor co-operation amongst different security agencies due to their reluctance in sharing information and hence, poor collaboration. Poor co-operation amongst security agencies has also manifested itself both in terms of lack of supply of information from national officers as well as in terms of transnational co-operation at the operational level (Busuioc, 2016). In the House of Lords European Union Committee (2008), it has been argued that smooth and free agency co-operation in the security sector is problematic as agencies and officers seek to protect their *turf*. Thus, agency co-operation (inter and intra), while was considered in a section of literature as essential was not supported in this study.

Hypothesis **H5**, which sought to determine the effect of information and knowledge sharing on optimal CDM, was supported in this study. Optimal CDM process (inter/intra) require information and knowledge sharing, joint decision making and co-ordinated intervention between and amongst the agencies/stakeholders involved in the process (Hughes-Morley et al., 2016). Through information and knowledge sharing there is a deeper understanding of the problem/task/challenge and an improved response to the problem (Hipple, McGarrell, O'Brien, & Huebner, 2017). This is because, information and knowledge sharing amongst the agencies/organizations/stakeholders is directly associated with the attainment of optimal CDM. Thus, through sharing information amongst and within organizations, unforeseen scenarios can be timely identified and acted upon, thereby minimizing their impacts (Abbas, Norris, & Parry, 2018). Therefore, attainment of optimal CDM is directly associated with better information and knowledge sharing amongst agencies.

5.8 SUMMARY

Several factors are mentioned in literature, some of which are reaffirmed by the findings in this Chapter as optimal CDM influencers. The findings in this Chapter show that institutional elements (regulative, normative and cognitive-cultural) significantly influence the attainment of optimal CDM amongst inter/intra agency collaboration. Three main insights related to the three elements of institutional theory (regulative, normative and cognitive-cultural) present the prime contribution of the findings in this Chapter in the context of CDM in Information Systems (IS).

The regulative elements (e.g. law and order) are showed in the study to have a strong impact on intra/inter agency collaboration (H1a, H1d and H4). To IS researchers, regulative elements provide them with necessary knowledge and understanding on how the organizational environment impacts organizational behaviour. The study's findings also revealed that the normative elements (e.g. norms and values) also influence inter/intra agency collaboration (H1c, H2a and H2b). Normative elements are essential to IS researchers since they assist with examining and explaining the nature of behaviour of employees in an organizations and why things are done in particular manner. Cognitive-cultural elements are also presented in the study to impact inter/intra agency collaboration (H3a and H3b). To IS researchers, this element is key in understanding and accepting that organizational operations are different and therefore, what works in Organization A can fail to work in Organization B. All these elements are important to IS researchers as they assist in understanding why change, practices such as collaboration and IT adoption in organizations are crucial but difficult to achieve successfully.

Theoretically, this study contributes to literature by developing and testing a model. The theoretical model developed can be used in other studies and/or applied in organizations that are interested in investigating factors influencing collaboration in decision making. Practically, the findings in this Chapter provide useful insights to agencies/stakeholders, policy makers and decision makers on the factors that require consideration for successful attainment of optimal CDM, not only in emergencies but also in the organizations. Organizational leaders and decision makers (management) should realize that although attainment of optimal CDM is problematic, there are measures that can be put in place so as to facilitate the success in attaining optimal CDM.

Despite the study's contributions to literature, it had some limitations. For instance, even though the study was based in the context of Africa, an in-depth knowledge on the attainment of optimal CDM and its determinants still needs exploration. However, since this study contributes to body of knowledge by highlighting the factors influencing attainment of optimal CDM in emergencies and in particular amongst counter-terrorism agencies, the proposed hypotheses in the study could be applied and tested with data from any part of the world. Due to data limitations the researcher failed to conduct a comparative analysis which can be a quest for future studies.

In the next Chapter, the context-aware collaborative decision making framework is developed based on the findings of this Chapter and those of Chapters 5 and 2.

Chapter 6: Towards A Context-Aware Collaborative Decision Making Framework

6.1 INTRODUCTION

The main objective in this study was to investigate how CDM could be enhanced through the use of context-aware technologies amongst counter-terrorism organizations. To realize this objective, a pragmatist view was adopted and Design Science Research (DSR) procedure followed. Pragmatist approach draws heavily on the inductive and the deductive reasoning and is good for answering the “what”, “why” and “how” research questions. DSR on the other hand, focus on addressing real-world problems such as terrorism, poverty and climate change amongst others through building of DSR artifacts (e.g. frameworks) - the final product in this study.

A framework is a skeleton of intertwined items, which supports a particular approach towards a definite objective and can be adapted to fit reality if need be. In this study the establishment of how CDM could be enhanced using context-aware technologies (*research question 3*) involved the development of the CA-CDM framework. The development process commenced by a recap of the research question (Section 6.2), a synthesis of the findings of Chapters 4 and 5 (Section 6.3) followed by the development of the CA-CDM framework (Section 6.4). The proposed CA-CDM framework is evaluated in Section 6.5 and its final form presented in Section 6.6. Section 6.7 gives the reflections on the developed framework and in Section 6.8, the Chapter concludes with a summary.

6.2 A REVISIT OF THE RESEARCH QUESTION

Collaborative Decision Making (CDM) as discussed in literature and presented in Chapter 2 of this thesis is an important process in addressing complex-problem situations such as terrorism. However, its attainment in complex problem situations has been elusive and problematic. This is because of the stakeholders involved in complex-problem situations belong to organizations with varied culture and structure, multiple perspectives and different frames of references etc. It is this nature of these

organizations that are the *Achilles heel* in the attainment of optimal/effective CDM. This assertion is reaffirmed by case studies such as the Westgate Mall attack, Garrissa University attack and the DusitD2 hotel attack in Kenya. Nevertheless, the availability and access of context-aware technologies (e.g. mobile phones, tablets, laptops) and their improved functionality is presented in literature as one of the ways OCDM could be enhanced and hence, the research question,

How can optimal/effective CDM be realized within the context of terrorism through context-aware technologies?

6.3 LESSONS FROM EMPIRICAL OBSERVATIONS

From the empirical analysis of Chapter 4 and Chapter 5, a Context-Aware Collaborative Decision Making Framework (CA-CDMF) was developed drawing from inferences in Chapter 2.

The emphasis of **Chapter 4** was to explicate the role of digital technologies within the terrorism biome (digital terrorism ecologies). A link between Soft Systems Methodology (SSM) and the theory of synergetics was drawn through associating CATWOE elements (Customers, Actors, Transformation, World view, Owners and Environment) to the core elements of the theory of synergetics (Micro level (system elements), Macro level (Order parameter), Control parameter, System constraints (internal and external) and Environment). Based on the theory of synergetics, Digital Terrorism Ecology (DTE) was synthesised as consisting of five main parts namely; *Open Digital Infrastructures (ODI)*, *Digital Information Ecosystem (DIE)*, *Digital Terrorism Enactment (DTE)*, *digital capability* and *digital enslavement*. The findings from this analysis painted the fluid nature of the structure of terrorism and the increasing role of digital technologies in influencing the evolution of the terrorism ecology.

An investigation on the CDM enablers on OCDM is presented in **Chapter 5** and the findings drawn from survey data collected from counter-terrorism organizations (the police, intelligence services, immigration department, criminal investigation unit and anti-terrorism units). Grounded on institutional theory (Chapter 2, Section 2.4.2) and a review of literature (Chapter 2), six constructs (Technological Infrastructure and Inter-Operability (TI), Information and Knowledge Sharing (IKS), Organizational

Form (OF), Group/Departmental Relationships (GDR) and Organizational Cooperation (OC)) and their respective indicators/measures/items were identified. The findings of this study, further exemplified the three pillars of institutional theory (regulative, normative and cognitive-cultural). The role played by institutional environment on organizational behaviour was found to significantly influence the attainment of OCDM. Similarly, attainment of OCDM amongst participating organizations, in particular counter-terrorism was depicted as challenging since it is characterized by several factors. Hence, the findings revealed that context (organizational) has a significant influence on the attainment of OCDM.

6.4 CA-CDM FRAMEWORK

In order for the developed framework in this study to be relevant to both practitioners and scholars, there was need to draw on information and knowledge from various fields including; computer science, management sciences, psychology, information systems, sociology, security studies, health and decision sciences amongst others. The framework development process began by a literature search on collaboration, decision making, CDM, organizational decision making, digital technologies, context, context-awareness, mobile devices, forms of terrorism, *modus operandi* of terrorists, effects of terrorism and terrorism groups, counter-terrorism organizations (Chapter 2). This was followed by an integration of the empirical findings (Chapter 4 and Chapter 5). Drawing guidance from previously developed conceptual frameworks grounded on empirical studies, the CA-CDM framework was developed.

Amongst the frameworks reviewed were; collaborative governance frameworks (Emerson, Nabatchi, & Balogh, 2012; Newig, Challies, Jager, Kochskaemper, & Adzersen, 2018), collaborative context-awareness frameworks (Alhamid et al., 2016; Mitchell, Meyers, Wang, & Tyson, 2011; Toch, 2011), collaborative planning frameworks (Cole, Sharvelle, Grigg, Pivo, & Haukaas, 2018) and collaborative capacity frameworks (Foster-Fishman et al., 2001; Hocevar, Thomas, & Jansen, 2006). A survey of the above frameworks informed the development of the proposed CA-CDM framework in this study. The proposed framework (CA-CDM) is presented in Figure 6-1 and its diagnosis given in Table 6-1.

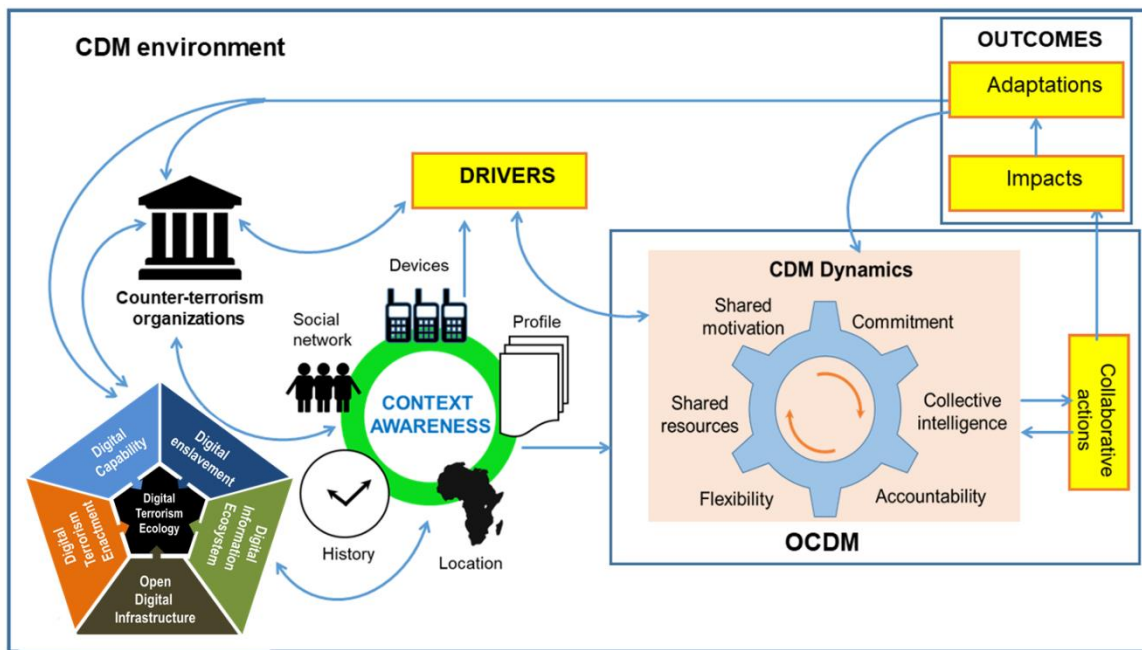


Figure 6-1: Proposed framework

In Figure 6-1, the CDM environment has the power to influence the attainment of OCDM as well as generate opportunities and constraints (drivers) which influence CDM dynamics from the onset and over time. This is what forms the foundation for the attainment of OCDM. The CDM dynamics consists of the basic principles the actors (counter-terrorism organizations) ought to practice for the successful attainment of OCDM. These principles include: shared motivation, collective intelligence, flexibility, accountability, shared resources and commitment.

The focal aspect of the framework and of this study is OCDM. It consists of CDM dynamics and collaborative actions, both of which work in unison for the success and attainment of OCDM. The successful practice of the basic principles in CDM dynamics yields collaborative actions that promote or hinder successful attainment of OCDM in an organization. Additionally, the collaborative actions can also act as fodder for effective, successful and continual practicing of CDM dynamics' basic principles.

The CDM environment is composed of the drivers, digital terrorism ecologies (DTE), actors, context-awareness, OCDM and the outcomes (see Figure 6-1).

Table 6-1: A logic model for the proposed framework

Elements	
Drivers	Trust, communication, IT infrastructure and inter-operability, organizational perspectives (e.g. culture, structure, governance, leadership), information and knowledge sharing, informal relationships
DTE ecologies	<p><i>Open Digital Infrastructure (ODI)</i>- Internet infrastructure, social media platforms (e.g. Facebook, Twitter), cloud computing, society</p> <p><i>Digital Information Ecology (DIE)</i>-Socio-economic imbalances-> poverty, grievances and extremism, privacy rights, politics, religious beliefs</p> <p><i>Digital Terrorism Enactment (DTE)</i>- Policies, ideologies, open models of information sharing (e.g. collaboration), strategy, data, technologies, activities</p> <p><i>Digital Capability (DC)</i>- Institutional rivalry and organizational perspectives (e.g. norms and values)</p> <p><i>Digital Enslavement (DE)</i> - Collective intelligence (co-operation/collaboration), open governance models (collaboration, transparency and participation).</p>
Actors	<p>Terrorist organizations (e.g. Al-Shabab, Al-Qaeda)</p> <p>Counter-terrorism organizations (e.g. police, intelligence units, criminal investigation units, immigration units)</p>
Context-awareness	Mobile devices (e.g. smart phones, tablets, laptops etc.)
CDM dynamics	Shared motivation, flexibility, shared resources, commitment, collective intelligence and accountability.
Actions (collaborative)	<p>Improved management practice.</p> <p>New policies for CDM practices amongst counter-terrorism organization.</p> <p>Improved information and knowledge sharing.</p> <p>High standards of accountability amongst counter-terrorism organizations.</p> <p>Cost effective decision making (through use of digital technologies).</p> <p>Enhanced consensus building.</p> <p>Enhanced communication.</p> <p>Foster collaborative relationships amongst counter-terrorism organizations.</p>
Impacts	Leads to adaptations.
Adaptations	Changes the pre-existing conditions within CDM dynamics, counter-terrorism organizations as well as in the DTE.

6.4.1 Drivers

Within the CDM environment, the drivers are the catalysts that evolve the CDM dynamics so as to attain OCDM. In this study, the identified drivers were either constructs of CDM enablers or their indicators (Chapter 2 and Chapter 5). These

drivers may also be a trigger or inhibitor to the functions of counter-terrorism organizations. They include:

a) *Trust*

In complex-problem situations which requires inputs from multiple actors, trust amongst the actors is achieved when each of the actors make an effort to; act in accordance with the commitments arrived at, both explicit and implicit (accountability), be frank and candid in all the negotiations that preceded the commitments and treat each other equally, fairly and with respect (Cummings & Bromiley, 1996; Heath, Appan, & Gudigantala, 2017). According to Ostrom (2009), collaboration (collective action) depends on: trust, reciprocity, and reputation.

Studies have shown that trust is a crucial component of collaboration. However, attainment of trust amongst actors takes time and nurturing (Axelrod, 1997; Huxham & Vangen, 2013). In addition, trust has been found to influence information exchange and informal relationships between actors (Koppenjan & Klijn, 2004) and also empowers the actors to go beyond self (Bardach, 1998; Thomson & Perry, 2006). In concurrence with the above studies, the findings in this study depicted trust as crucial for inter/intra organizational collaboration and information exchange and through informal relationships trust can be built.

b) *Communication*

Success in collaboration in multi-stakeholder situations is directly linked to communication and trust (De Regge et al., 2018). In addition, communication is a critical element in developing policies and practices related to confidentiality and information sharing. All of which are essential for collaboration (Frost & Lloyd, 2006). Lack of communication has been exemplified in this study as a deterrent to the attainment of OCDM mainly due to institutional rivalry and differences in organizational cultures (Kaunert, 2018). This practice (poor-communication) has contributed to ineffective response amongst counter-terrorism organizations to terrorism and its associated effects (Chukwu, 2018).

c) *Culture*

The culture in the organization (values, beliefs and systems) can be either visible or invisible and may boost or inhibit collaborative practices in/by the organization (Al-Alawi, Al-Marzooqi, & Mohammed, 2007; Razmerita et al., 2016). Hence, each

organization has a unique culture that reflects the organization's identity. An organization's visible culture (values, mission and philosophy) is often nurtured over time while its invisible culture, which consists of the norms and values, guides its employee's behaviour and actions. In situations where multi-organisations are involved, the visible and the invisible cultures influence the attainment of OCDM as was observed in Chapter 5.

d) *Leadership*

A leader as described by Alexander, Hearld and Mittler (2011) is a person who influences others to achieve a common goal which in this case is attainment of OCDM. It is inherent of a good leader to exhibit impartially, be neutral and committed to collaborative problem solving (Emerson et al., 2012). In short, a good leader is one who is task-focussed, promotes productivity and thus brings tangible benefits to members like attainment of OCDM (D'anno, Alexander, & Jiang, 2017).

e) *Governance*

Fostering collaboration entails the setting up of an appropriate governance mechanism. Governance is a set of norms/rules for coordinating and monitoring collective decision making, behaviours, activities, and relationships amongst the stakeholders (Bingham & O'Leary, 2006; Bryson et al., 2006; Elinor, 2005). Given that most collaborative efforts involve joint decision making and resource sharing between stakeholders with conflicting personal goals, having an appropriate governance structure is the key to the survival of the collaborative partnership (Stoker, 2004). Governance provides the mechanisms for stakeholders to make choices on how to solve shared problems and is a key dimension of collaboration (Thompson & Dean, 2009). Nevertheless, the absence of governance structure restricts the ability of individual organizations to meaningfully participate in CDM practices an observation consistent with the findings in this study.

f) *Informal Relationships*

The role of informal relationships in collaboration work situations has also been exemplified in this study. The ethos that inter-personal and inter-organizational relationships anchored on trust and reciprocity creates a truly collaborative network has been reaffirmed by the findings of this study (Whelan, 2017). The nature of the

formed relationships (informal) in the collaborative networks, are actually more significant than the resources available in the networked environment (Lavie, 2006).

It has been established by Kilduff and Krackhardt (2008) that these relationships can exist either at the micro (interpersonal) or the macro (inter-organisational) level. The former is grounded on inter-personal trust while the latter is grounded on inter-organizational trust and hence networks which experience enhanced collaboration are likely also to exhibit high levels of trust (Whelan, 2017).

g) *Information and Knowledge Sharing*

Information and knowledge sharing in complex-problem situations is influenced by the nature of information to be shared, organizational culture (Janz & Prasarnphanich, 2003), personal relationships, social networks, the motivation to share and the rewards for sharing amongst others (Gaál, Szabó, Obermayer-Kovács, & Csepregi, 2015). The findings in this study showed that information and knowledge sharing is an important factor in the attainment of OCDM. In a collaborative environment, digital technologies offers a platform for information and knowledge exchange either through context-aware devices (e.g. mobile phones, tablets) or structured and unstructured data bases. It is therefore imperative for the actors and/or organizations to equip themselves with the relevant IT infrastructure and skill-sets so as to fully exploit the digital space.

h) *Technological Infrastructure and Inter-Operability*

Technology can either enhance or enslave the collaborative efforts within and without an organization. This is because it is the main facilitator of information sharing and communication between actors in a multi-actor environment. The affordance of the current digital landscape has differentiated organizations in terms of both technical infrastructure and inter-operability. With the advancements in ICT, big data, cloud computing, nomadic computing, and the open digital landscape, information and knowledge exchange is now more feasible regardless of the geographical locations of the actors in a collaborative environment (Odero, Ochara, & Quenum, 2017). This can be achieved if these technologies are hosted on a context-aware device that is well-designed, user-friendly and has reliable technical support (Graves & Doucet, 2016).

In compatible systems and classification levels, access restrictions and information security and perceptions of data ownership are some of the key challenges

inter-operability poses in inter/intra organizational collaboration environment (Abbas & Norris, 2018). Some of these challenges can be overcome through multiple information channels, better ICT preparedness, and civic education on the use of alternative communications channels during collaborative work (Coiera, 2015).

6.4.2 Digital Terrorism Ecologies (DTEs)

The digital evolution has evolved the perceptions and opinions of the modern society. It has modified the social fabric in that, human-human interaction has decreased with increasing human-technology interactions. This has resulted in users storing/retrieving most of their information (public, personal and private) on open digital platforms. The modern day consumer of the associated digital evolution technologies uses it for communication (WhatsApp, Skype, HangOuts, Facebook, and Twitter etc.), navigation (GPS, Google Maps and Waze etc.), financial transactions (Internet and Mobile banking technologies), transportation (Uber, Lyft and Taxify etc.), tourism and travel (destination and associated recommender systems) and social networking (Facebook, Twitter, Instagram etc.) (Pérez-Torres et al., 2016; Yürür et al., 2016). In spite of the advantages of this digital evolution, it poses a threat to privacy and data security that can be exploited anonymously by hackers, targeted advertisements, security (counter-terrorism) agencies and even terrorism organizations etc. (Sicari et al., 2015). It is these affordances of technology evolution that informs the Digital Terrorism Ecology which consists of the Open Digital Infrastructure (ODI), Digital Information Ecosystem (DIE), Digital Terrorism Enactment (DTE), digital capability and digital enslavement.

6.4.2.1 Open Digital Infrastructure

The Open Digital Infrastructure (ODI) which includes the increased connectivity, scale, speed and transparency of the Internet has expounded the terrorism nuisance through the interaction of the actors (terrorists and counter-terrorism organizations) with the open digital infrastructure (Gillespie et al., 2018). This is because while some counter-terrorism measures are anchored on digital information (data bases) and intelligence, terrorism organizations have circumvented this caveats by either scrubbing their online profile or remaining anonymous (Bartlett & Krasodonski-Jones, 2015; Lieberman, 2017).

6.4.2.2 Digital Information Ecosystem

The openness of the digital space affords equal access to information to both the terrorists and counter-terrorism organizations and hence the Digital Information Ecosystem (DIE). DIE is the exploitation of technologies such as the Internet to deliver/convey both constructive and destructive information. It has given the modern terrorist a voice. Using the DIE affordances, the terrorist is able to exploit benign tools normally used for confidential interactions, privacy, and other legitimate purposes for nefarious purposes (Tsesis, 2017). They are also able to mask their activities using technologies such as the dark net as well as anonymous networks including Tor, I2P, and Freenet. DIE has also been exploited for political and ideological protest (Hajj et al., 2019) that have resulted in digital uprisings such as the ‘Arab Spring’ (see Elsayed & Wahba, 2019) and ‘Black Lives Matter’ movement (see Honwana, 2019).

6.4.2.3 Digital Terrorism Enactment

The digital space has also evolved terrorism ideologies, strategies and counter strategies as well as policies and hence the *Digital Terrorism Enactment*. This enactment can be attributed to the sociomaterial nature of modern society (Gaskin et al., 2014; Nambisan, 2017). An employment of the *Enactment* perspective is likely to lead to the admixture of digital artifacts and their capabilities with the human actors and this result in the fomentation of the dynamic emergence of terrorism and counter-terrorism activities underpinned by dominant ideologies, policies, strategies, etc. Therefore, the emphasis of the *Digital Terrorism Enactment* is in how terrorism and counter-terrorism plays out in reality.

6.4.2.4 Digital Capability

The ability/capacity of the actors (counter-terrorism and terrorist organizations) in employing digital technologies is the digital capability and it varies from organization-to-organization. It can either enslave or enhance collaborative efforts between agencies involved in collaborative counter-terrorism tasks. This is because the collaboration efficiency can be hampered by the organizations being at different levels technologically and skill-set wise. Technology is constantly improving the operational effectiveness of terrorists groups as it aids them in obscuring contacts, plans and co-ordination (Berman, 2019). Advancements in digital technologies has also led to end-to-end encryption tools, full device encryptions, anonymization of

Internet traffic, burner phones or “live” flash drives among others. This sophistication poses a great challenge for law enforcement and intelligence services in that they make terrorists more effective and defending against them more difficult. Hence, digital capability has made the terrorist more versatile and lethal. Among counter-terrorism organizations, differences in adoption and implementation of the digital infrastructure is likely to determine their preparedness, awareness and response to acts of terrorism as well as interagency collaboration (Campana & Légaré, 2010; Omand, 2018).

6.4.2.5 Digital Enslavement

Digital technologies’ ability to be an informer, an educator, a companion, a guide (navigation), a library and a consultant, has made the society to dependent on them (Pink, 2016). The society now heavily relies on these abilities of digital technologies to appoint where reason is derived from these technologies (Markham, 2016). This has resulted in these technologies reshaping, redefining and re-inventing ideologies such as “who is a terrorist”, “what informs a terrorist” as well as “what is terrorism” (Haque, 2016). Digital technologies depending on the user may define a terrorist as “a Muslim”, “an Arab”, “someone with a hijab”etc. All of which equally defines the characteristics of a true Muslim who is not necessarily a terrorist and hence, many people who rely on digital technologies for information may end up believing the information obtained thereof. Further, “what informs a terrorist?” Thanks to the affordances of digital technologies, counter-terrorism agencies as well as IT administrators in institutions are able to tract search histories on websites and conclude that a user is a terrorist or terrorist sympathizer based on their search histories (Tthesis, 2017). These search histories may contain “how to make an explosive, how to obtain chemicals, how to access the dark web, how to be anonymous online etc.” Finally, “what is terrorism?” Different countries, agencies, organizations, communities etc. define terrorism differently (Sandler, 2011). Hence, what is defined as terrorism in country A might be a criminal act in country B and since the users in these two countries relies on digital technologies to define for them what is terrorism, the information they access from these digital technologies defines their thinking hence enslaving them. The above instances elaborate the ability of these digital technologies to exercise control over the users and hence enslaving their minds, ideas and thoughts. These poses a challenge to counter-terrorism organizations as they try to combat the terrorism menace in any society.

6.4.3 Actors

The actors in the proposed framework can either be the counter-terrorism organizations (e.g. the immigration officers, the police, the intelligence units) or the terrorist organizations (e.g. ISIS, al-Qaeda or al-shabab). In the framework, the actors interact with DTE and context-aware technologies. Through their interaction with the context-aware technologies, the actors (terrorist organizations) are able to recruit, solicit funds and even spread propaganda (Blaker, 2015a; Paganini, 2016). For instance, using social media vehicles such as Facebook, WhatsApp, blogs and Instagram amongst others, the terrorists can freely spread ideologies (Hafez & Mullins, 2015). Equally, the open digital space (Internet) has allowed the terrorists to recruit new members, coach and even make financial transactions (Hatta et al., 2018; Neer & O'toole, 2014). Further, terrorists have also made use of the Internet to obtain information that they can use to support their actions such as; bomb making techniques, how to conduct an effective attack, how to assemble the bombs and where to obtain materials for making bombs etc. (Albahar, 2017; Hatta et al., 2018).

Conversely, through the interaction of the actors (counter-terrorism organizations) with context-aware technologies, platforms can be created to freeze assets of terrorists groups, removing and blocking accounts affiliated to terrorists' organizations, expanding government surveillance and putting sanctions against terrorism incitement etc. (Eijkman & Weggemans, 2011; Fidler, 2015). Further, with the help of "smart" surveillance or recognition technology for example, Closed Circuit Television Systems (CCTV); the stored information can easily be matched against real time images and used by governments to monitor their targets (persons) of interest (Bowcott, 2008). Consequently, surveillance technologies can also be used to collect group and individual "soft" intelligence. This information can be used by governments to monitor their targets as well as for investigation and interrupting terror suspect communication (Fenwick, 2011).

Hence, through interaction with DTE, the terrorist organizations are able to come up with counter strategies. Similarly, counter-terrorism organizations interaction with the DTE allows them to come up with new strategies that they can use to mitigate, solve or combat the ever evolving face of terrorism in the digital age. All of these interactions between the actors, DTE and context-aware technologies can either facilitate or deter the effective attainment of OCDM.

6.4.4 Context-Awareness

Ubiquitous computing as facilitated by context-aware technologies has on one hand significantly improved the quality of life of the users while on the other hand led to massive increase and vulnerability of terrorists attack globally (Albahar, 2017). Within the context of terrorism, the ubiquitous computing sphere is either enhancing or enslaving the counter-terrorism efforts by the actors (counter-terrorism organizations). This is because the *terrorist* is now more techno savvy and has unlimited access not only to the social media vehicles (e.g. Facebook, Twitter, YouTube etc.) but to technology in general which gives them more (digital) power to recruit, radicalize, train and instil fear and panic (Gillespie et al., 2018; Lieberman, 2017). This therefore further complicates the digital counter-terrorism efforts initiated or put in place as a safe guard to prevent terrorism related activities on these social media vehicles.

Since context-aware technologies (platforms) have the sensing capability (e.g. geo-tagging and location services), counter-terrorism organizations can exploit these capabilities to locate and monitor terror suspects, to monitor their digital foot prints on the digital space as well as investigate and monitor their social media environment (Berman, 2019; Weimann, 2014). This stopgap measure by counter-terrorism organizations is not foreign to the terrorists themselves hence, thanks to the affordances of ubiquitous computing (open digital space), the *digital terrorist* can counter these efforts through being anonymous online as well as having multiple digital identities (*digital counter power*) (Odhiambo et al., 2018; Tsesis, 2017). These illustrations show that although technology (context-aware technologies) is good for enhancing CDM, it can also be a constraint to the decision makers.

6.4.5 Optimal Collaborative Decision Making

Optimal Collaborative Decision Making (OCDM) is the interaction between the CDM dynamics and the collaborative actions. As presented in the proposed framework, the drivers are the triggers of the CDM dynamics. However, over time the changes and effective attainment of OCDM is influenced by its two components; CDM dynamics and the collaborative actions.

6.4.5.1 CDM Dynamics

As already mentioned above, the CDM dynamics are basic principles that need to be practiced by the actors (counter-terrorism organizations) for the overall success of the CDM process. When catalysed by the drivers (e.g. trust, leadership, communication), the practice of these principles can either inhibit or enhance the CDM process. It is this CDM dynamics that leads to (informs) the collaborative actions which in turn influence both OCDM as well as CDM dynamics itself. In the framework, the CDM dynamics consists of shared motivation, shared resources, commitment, collective intelligence, accountability and flexibility.

a) *Shared Motivation*

In a collaborative process, shared motivation has been painted as a critical component for successful collaborative practices (Ulibarri, 2015; van Dongen et al., 2016) and can either be intrinsic or extrinsic (Kim, Glassman, & Williams, 2015). Intrinsic motivation is individual/personal driven and is characterised by personal ideological drive, skills (e.g. conflict management skills), knowledge (on how other organizational work), need, attitude and willingness of an individual to participate in the collaborate process (Hocevar, Jansen, & Thomas, 2011). Whereas, extrinsic motivation is characterised by external factors for instance; financial incentives provided so as to motivate individuals to collaborate, rewarding employees for investing time in building collaborative relationships with other organization members and for successful collaborative results, considering collaborative talents and achievements when reviewing employees for promotion etc. In this study, shared motivation is considered as a practice that can yield actions which either enhances or limits the attainment of OCDM in a collaborative environment.

b) *Shared Resources*

In order for collaboration to be achieved in carrying out a specific task, there is need for the actors to share resources so as to maximize and leverage their utilization (Thomson & Perry, 2006). Sharing resources is instrumental during the collaborative process (Lubell, Leach, & Sabatier, 2009). By working together, organizations develop and maintain the resources necessary for the collaboration which may include funding, time, technical and logistical support; administrative and organizational assistance; requisite skills for analysis or implementation; and needed expertise, among others.

Similarly, power is also a resource and is normally distributed unequally amongst the actors (Bryson et al., 2006). Resource disparities (e.g. technological, skill wise, financial) amongst the actors can be a hindrance to the effective attainment of OCDM (Thomson & Perry, 2006).

c) Commitment

Ko\zuch and Sienkiewicz-Ma\lyjurek (2016) refer to commitment as the willingness to co-operate by sharing financial resources, physical assets, technological and managerial resources amongst others. On the other hand, Moorman, Zaltman and Deshpande (1992) describe commitment as “an enduring desire to maintain a valued relationship” (p.316). In this study, commitment is seen as the willingness by actors to co-operate/collaborate. When organizations have a commitment to a relationship (co-operate or collaborate), they invest in adequate resources so as to maintain the relationship and to make it successful (Sarkar, Echambadi, Cavusgil, & Aulakh, 2001). Commitment is a critical component of any collaborative work (Moshtari, 2016) and lack of it is one of the reasons for failure in collaborative partnerships (De Regge et al., 2018; Morgan & Hunt, 1994).

In a CDM processes, commitment is either individual-driven (personal) or organizational-driven. Organizational-driven commitment is the willingness of the organizations to share resources. According to Storbacka, Brodie, Böhmman, Maglio, and Nenonen (2016), commitment especially, willingness to share resource is a critical element of any collaborative relationship. For instance, investing in human and capital resources specific to the collaborative relationship is a tangible way of demonstrating dedication to the idea of achieving mutual benefits (Sager & Wilson, 1995). In this current study, the benefits of resource commitment emerges when the organizations in the collaborative work are willing to work towards a common goal (attainment of OCDM) by sharing information and resources with one another (Moshtari, 2016). The degree to which the organizations are willing to invest resource wise to the collaborative work is directly linked to the collaborative performance (Gulati, 1998).

d) Collective Intelligence

Collective Intelligence (CI) occurs when organizations act collectively in ways that seems intelligent (Woolley, Aggarwal, & Malone, 2015). However, it is not clear that all collective behaviour amounts to CI. With improvements in ICT and emergence

of Artificial Intelligence (AI), CI can be described as the intelligent use of human-machine interaction in complex-problem solutions resulting into production of desired results (Peters & Heraud, 2015). According to Chikersal, Tomprou, Kim, Woolley and Dabbish (2017) success in any collaborative work which involves multiple organizations or systems is highly influenced by CI. Hence in this study, CI is viewed as group intelligence (collaborative actions) geared towards achievement of OCDM.

CI has been a key determinant of future collaborative efforts between actors in complex-problem solutions (Woolley, Chabris, Pentland, Hashmi, & Malone, 2010). CI is dependent on the composition of the team, diversity of the team and social perceptiveness. Chikersal et al., (2017) have also reaffirmed these findings.

In this study, the CI concept is demonstrated in Chapter 5 as the use of CI by counter-terrorism organizations to come up with better counter-terrorism strategies and also by the terrorists in evolving their craft. As presented in Chapter 5, factors such as institutional rivalry and organizational perspectives (e.g. roles, norms, responsibilities) amongst counter-terrorism organizations had an effect on collectively harnessing the CI of terrorists throughout the world (Jaeger & Dunn Caveltly, 2019). The ineffectiveness of the counter-terrorism organizations in this study is linked to their poor use of CI to tackle terrorism. Despite global recognition that the effectiveness of CI rests on the principles of open governance (collaboration, transparency, and participation), the practice amongst counter-terrorism agencies contradicts this ethos. Conversely, the terrorist organizations' use of CI is linked to their ability to utilize digital technologies. The terrorist is no longer isolated, lone and unintelligent; but acts, urged forward through CI of a digitally-enabled global crowd of terrorists.

e) Accountability

Accountability is taking ownership of ones actions. Together with responsibility, communication, cooperation, co-ordination, assertiveness, trust, respect and autonomy, accountability is identified as a key element in the collaborative process (Bridges, Davidson, Odegard, Maki, & Tomkowiak, 2011). Accountability is frequently applied in the context of maintaining financial 'accounts', which demonstrate that funds have been used appropriately. It evokes a sense of taking responsibility but it also holds the meaning of being held responsible by others; being

'held to account'. In the context of CDM, it refers to holding the organizations involved in the CDM process responsible for their actions and their consequences (Cornwall, Lucas, & Pasteur, 2000). Accountability in a collaborative environment requires the actors to fully understand and agree to their obligations and rights, and believe that the other will also act accordingly (Fountain, 2013).

f) Flexibility

Flexibility in a collaborative process entails the actors' willingness to act outside their comfort zone, roles, duties and functions for the overall success of the collaborative task (Abbas & Norris, 2018; Kapucu & Garayev, 2011). It is also an actor's willingness to adapt to changes in collaborative environment (de Walle & Turoff, 2008; Fischer, Thomé, Scavarda, Hellingrath, & Martins, 2016). In relation to CDM environment, flexibility is associated with high levels of collaboration amongst organizations (Richey, Adams, & Dalela, 2012). To establish flexibility in the collaborative environment, a meaningful integration and coordination amongst and between collaborative actors is vital (Singh & Acharya, 2013).

6.4.5.2 Collaborative Actions

The aim of any collaborative work is the coming together of people and organizations so as to address problems that are complex in nature and requires varies skill sets and levels of expertise (Emerson & Nabatchi, 2015). In the context of OCDM, collaborative actions may include; new policies for CDM practices amongst counter-terrorism organization, improved information and knowledge sharing, high standards of accountability amongst counter-terrorism organizations, cost effective decision making (through use of digital technologies), enhanced consensus building, enhanced communication and foster collaborative relationships amongst counter-terrorism organizations etc. (Connick & Innes, 2003). These actions have an effect on the OCDM process itself and the CDM dynamics. To the CDM dynamics the actions may lead to improved or poor working conditions amongst counter-terrorism organizations.

6.4.6 Outcomes

In a collaborative process, the outcomes of such processes have been derived based on the theoretical perspectives that informed the research. For instance, Logsdon

(1991) refers to solutions of real problems in collaborative settings as a successful outcome. Ostrom (1990) views self-governance as a positive outcome of a collective action. Huxham (1996) argues that collaborative outcomes can either be instrumental or ideological- in that through continuous interactions between organizations, concrete goals can be collectively achieved and long-term substantive social changes may occur. Thomson, Perry and Miller (2014) concurred with all the arguments above and hence, based on Thomson et al., (2014), this study considers a collaborative outcome as: (1) problem resolution or goal achievement; (2) generation of social capital; (3) creation of shared meaning; (4) changes in network structure; and (5) shifts in power distribution. The outcomes are divided into impacts and adaptations.

6.4.6.1 Impacts

As indicated in the proposed framework (Figure 6-1), impacts are the desirable changes needed (or deemed necessary) for the success of the attainment of the goals of the CDM process. Impacts occur in a variety of forms and can be political, social, economic, technological and physical amongst others (Emerson et al., 2012). Impacts are the observable results which influences both the CDM dynamics and the actors (both counter-terrorism and terrorists' organizations). The impacts from the collaborative actions can be short, medium and long term. Short term impacts are easier to achieve unlike long term ones.

6.4.6.2 Adaptations

In the framework, adaptations can be described as responses to outcomes of collaborative actions (Emerson & Nabatchi, 2015). Adaptation may occur on a small or large scale, and within the counter-terrorism organizations, OCDM, DTE and CDM dynamics. For instance, adaptation by the actors (counter-terrorism) will determine if the actions solved the problem or not, if new or different sets of challenges or opportunities arise or not. Adaptations might also influence the attainment of OCDM directly or indirectly as a result of changes in the drivers or directly in response to the perceived effectiveness of actions and outcomes (e.g., leading to a new charge or mandate, a new round of knowledge generation or resource leverage, or the decision to disband the collaborative task). Adaptation may also occur within the DTE in that the terrorists within the DTE adapts to the changes put in place by the counter-terrorism organizations so as to be able to continue with their practices.

6.5 EVALUATION OF THE FRAMEWORK

This study followed DSR methodology in the development of the CA-CDM framework and as stated in Section 3.4.1, Chapter 3, framework evaluation is essential in assessing the validity, utility and quality of the developed framework (March & Smith, 1995; Venable, Pries-Heje, & Baskerville, 2014). In this study in order to evaluate the developed DSR artifact (Figure 6-1) focus group interviews were used.

6.5.1 Data Collection

For the framework evaluation, two focus group interviews consisting of 6 participants each were used. Each of the focus group sessions lasted for about 2 hours and was facilitated by the researcher. The expertise of the drawn participants in each of the focus groups was from information systems (4), computer science (2), engineering (4) as well as security studies (2). The inclusion criterion for participating in the focus group was based on the participants' knowledge and their expertise in relation to the problem under investigation in this study. Each focus group session commenced with a brief introduction on the research, its significance, its objectives and the proposed CA-CDM framework. This was then followed by a series of open-ended questions according to the focus group guide in appendix E. In order to facilitate continual discussions during the focus group sessions, the researcher occasionally inquired from the participants if they needed further clarification at any point. The responses from the focus group interview were digitally recorded and transcribed at a later stage.

6.5.2 Data Analysis

In order to identify, analyse and describe patterns in the data, an inductive thematic analysis as described by Braun and Clarke (2006) was used. An inductive approach allows themes to emerge from the data free of any preconceived ideas. Nvivo, a qualitative data analysis software, was used to carry out the inductive thematic analysis. This followed a six step approach: (1) Familiarizing with the data (2) Generate initial codes (3) Theme search (4) Review themes (5) Define and name themes (6) Produce report (see Section 3.6.1, Chapter 3).

6.5.3 Results

The results of the focus group interviews are presented in the sub-subsequent sections.

6.5.3.1 Focus Group 1

Three themes emerged during analysis. The themes were security, community policing and clarity.

a) Security

Security is essential in controlling information flow and for the developed framework to achieve its purpose, the participants advised the researcher that there was need for information filtration between; the drivers to CDM dynamics, context-awareness to CDM dynamics, community to counter-terrorism organizations and Digital Terrorism Ecology to counter-terrorism organizations. This is because corrupt and un-vetted information may lead to the framework not fulfilling its intended purpose.

In particular, the participants pointed out the need to filter information emanating from the interaction between the CDM dynamics and context-aware technologies. This is because as already mentioned in previous Chapters (2 and 4), context-aware technologies which form a critical part of digital technologies services both the terrorist and counter-terrorism organizations. Thus, both the terrorists as well as counter-terrorism organizations enjoy the affordances thereof of these digital technologies. Hence to some extent the terrorists can manipulate these affordances to further complicate the CDM process via the CDM dynamics. Additionally, the information emanating from the interaction between context-aware technologies and counter-terrorism organizations also need filtering due to the exploitation of these technologies by the terrorists. This exploitation is likely to pose a threat to counter-terrorism efforts. Hence, there is need therefore for counter-terrorism organizations to shield/protect themselves from threats such as hacking and unwanted access from the terrorists. Further, since terrorism in the digital age informs the Digital Terrorism

Table 6-2: Security

Participant	Text	Description	Interpretation
P6	<i>“there is need for some policies in that even though digital technologies provides equal opportunities, rules should be put in place that only allows counter-terrorism organizations to get all information but not the terrorists”.</i>	Need for policies that protect	Security

P1	<i>“I think the level of information that terrorism can get from the counter-terrorism organizations should also be limited.</i>	Control of information	Security
P2	<i>“what will the counter-terrorism organizations do if someone (e.g. a terrorist) poses a threat to the system? Your framework needs a form of protection just the same way a computer has an anti-virus for instance”.</i>	Protection	Security
P3	<i>“you want to ensure that information is protected for the framework to work effectively there is need for gates”.</i>	Information protection	Security
P1	<i>“if there is no protection the terrorists and the counter-terrorism organizations will just be following one another”.</i>	Counter-terrorism protection	Security
P4	<i>“... how are the counter-terrorism organizations protected such that there information is not leaked?”</i>	Leakage	Security
P6	<i>“we do not want them to work for the other group (terrorists)”</i>	Protection	Security
P5	<i>“there may be a false alarm for example this guy thinking its terrorism and its false alarm and counter-terrorism organizations are already running ...”.</i>	False alarm	Security

Ecology, with terrorists and their associated activities at the core of this ecology, there is need for counter-terrorism organizations to come up with safe guards to prevent this ecology from manipulating their strategies. All of the above indicate the need for counter-terrorism organizations to be proactive rather than reactive when it comes to terrorism in the digital age. Table 6-2 presents the direct quotes from the participants in support of the theme, security.

b) Community Policing

In order for the framework to be effective, the participants advised the researcher that citizens ought to be part of the community. This is because they can play a key role in providing information to counter-terrorism organizations that may be used in combating terrorism. In Kenya for instance, community policing initiatives such as

Nyumba kumi can be an asset to counter-terrorism activities and strategies within the country.

While the community might have good intentions in assisting counter-efforts, there is need for information from the community to be vetted for correctness with the aim of avoiding false flags. This is because, thanks to the affordances of digital technologies (context-aware technologies), ideologies, definitions and perceptions of the community are modified to some extent by the society they live in and hence, lack of civic education may lead to misinformation due to profiling, fundamentalization and radicalization by the community. Table 6-3 gives the direct quotes from the participants in support of the theme community policing.

Table 6-3: Community policing

Participant	Text	Description	Interpretation
P4	<i>“what about the ordinary people where are they catered for in the framework?”</i>	Relevance of ordinary people	Community policing
P6	<i>“the common man might be having more information think about the nyumba kumi initiatives in Kenya”.</i>	Relevance of ordinary people	Community policing
P3	<i>“look at what is happening in Mombasa Kenya for instance, the common people might be having more information than even the counter-terrorism organizations but they are not taken care of as part of countering terrorism in the region”.</i>	Relevance of ordinary people	Community policing

c) Clarity

It was also pointed out by the participants that the framework as drawn was cluttered making it difficult to understand how the components interact with each other (P2, P1 and P3). The participants unanimously agreed that the arrows as used in the framework were confusing and hence there was need to re-draw them to make the envisaged interactions clearer (P1). The participants also highlighted that the relationship between context-awareness and the devices was also not clear to participant 3 and hence the researcher was advised to explicitly indicate that the devices regarded as context-aware in the framework are smart devices.

Table 6-4: Clarity

Participant	Text	Description	Interpretation
P2	<i>“the framework is busy there is need for less congestion and some clearness”.</i>	Need for some clearness	Clarity
P1	<i>“there is lots of arrows pointing where and there causing some confusion”.</i>	There is confusion	Clarity
P3	<i>“this context-awareness, is it the devices you are concerned with or the data from these devices because as it is as little bit confused”.</i>	Information confusion	Clarity
P6	<i>“the drawing as it looks is not right, the arrow from the collaborative actions should be a result of the whole box (OCDM). The way it is it indicates that you are integrating two factors but you will only take collaborative actions as a result”.</i>	Output not fully captured	Clarity
P1	<i>“who are the players in this framework? There is need for some relationship between the players and OCDM”</i>	Beneficiaries	Clarity
P5	<i>“who are practicing this OCDM? There is no direct relation/link between the OCDM and the players in the framework”.</i>	Practitioners	Clarity

Another suggestion from the participants was to change the interaction between collaborative actions and impacts to OCDM and impacts. This was because the output

of the CDM dynamics was OCDM and not just collaborative actions (P3). Further, since the framework was being developed for counter-terrorism organizations, there was a suggestion that the researcher should show some relationship between counter-terrorism organizations and OCDM (P5). Table 6-4 gives the direct quotes from the focus group discussions in relation to Clarity.

6.5.3.2 Focus Group 2

After the first focus group interview, amendments were made to the initially developed framework and then presented to the second focus group. Two themes emerged from the analysis of the second focus group discussions namely, objective and clarity.

a) Objective

The participants in the focus group indicated that the framework was hanging since the objective of the study (combating/preventing/mitigating terrorism) was not captured. This was because the overall goal of the framework was for counter-terrorism agencies to practise collaboration in decision making so as to be able to prevent/combat/mitigate terrorism effectively. The participants therefore suggested including this information within the framework. See Table 6-5 for supporting quotes on the theme, objective.

b) Clarity

All the participants were in agreement that there was need for the developed framework to have clear symbols and legends to make it easy for the user to understand the envisage meanings of the components and their associated interactions. Additionally, the participants also observed that some of the interactions were between the components of the framework were confusing and there is need for clarity between the interactions and the feedback loops. Table 6-5 gives the direct quotes in relation to this theme, clarity.

Table 6-5: Objective and clarity

Participant	Text	Description	Interpretation
P2	<i>“looking at the title of your study and the developed framework the overall goal is missing you need to add a box representing combating terrorism”.</i>	Goal of the framework	Objective

P1	<i>“what are those closed X’s in the framework and what do they convey”.</i>	Legend/Key	Clarity
P4	<i>“I think the framework needs a legend/key if included will make it easy for the reader to understand the message being conveyed by the framework”.</i>	Legend/Key	Clarity
P2	<i>“you can maybe use dotted and full line arrows to distinguish between the forward and the feedback loops”.</i>	Loop distinction	Clarity

At the end of the two focus group interviews, both of the focus groups affirmed that the role of digital technologies was well captured within the framework as envisaged by the study. The next Section presents the final CA-CDM framework.

6.6 PRESENTATION OF THE FINAL CA-CDM FRAMEWORK

In Section 6.4 of this Chapter, the proposed CA-CDM framework was developed (Figure 6-1) based on literature, findings of Chapter 4 and Chapter 5. In the Section 6.5 of this Chapter the proposed framework is evaluated using focus group interviews to determine its credibility. This is done to make sure that the developed CA-CDM framework is able to achieve its purpose. During the evaluation process, there was no deletion of any of the initial concepts shown in Figure 6-1 however, there were suggestions for insertions of new components. The edited framework based on the suggestions of the focus groups is presented below.

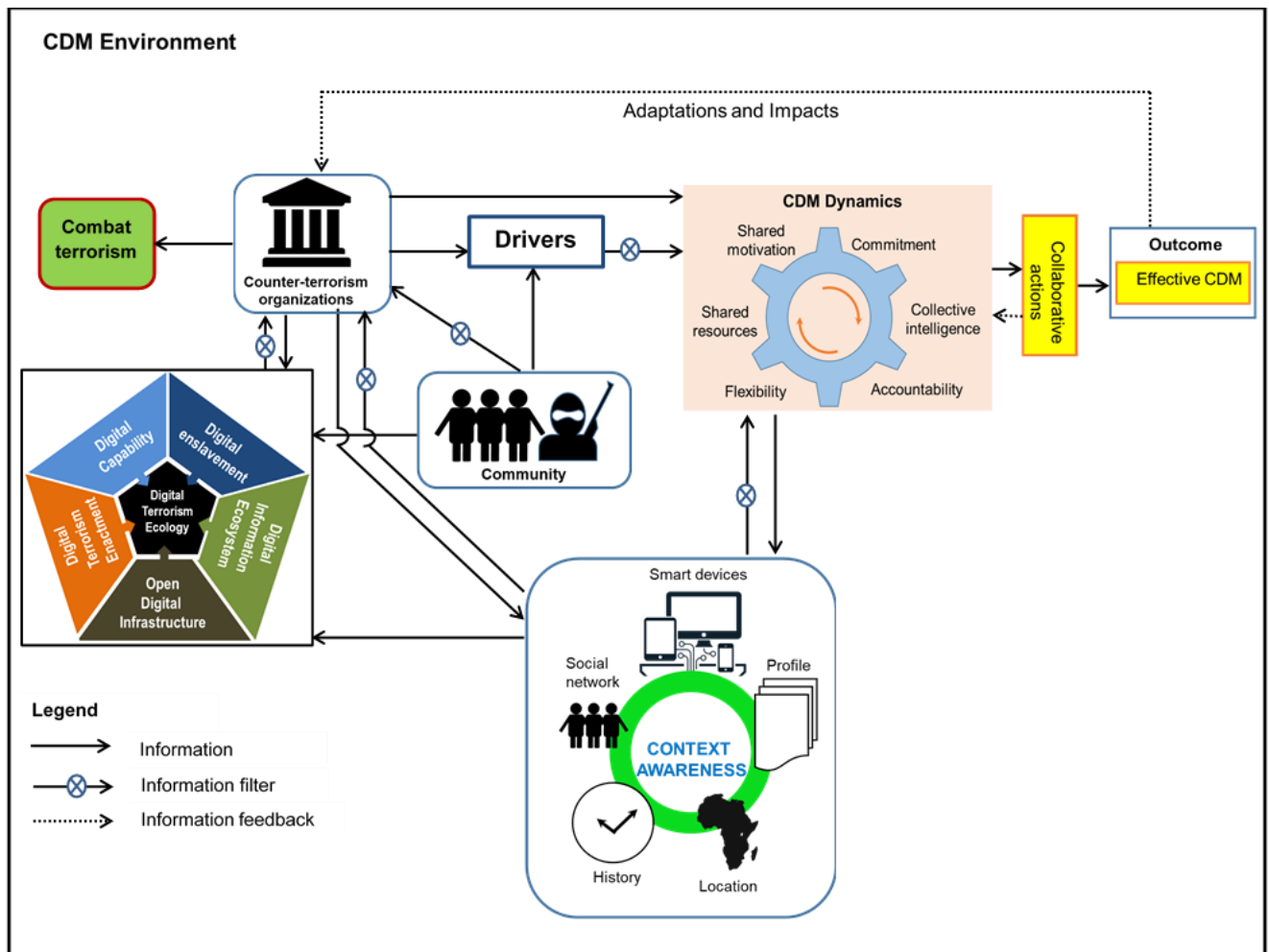


Figure 6-2: The final CA-CDM framework

6.7 REFLECTIONS ON THE FRAMEWORK

The developed CA-CDM framework (Figure 6-3) offers new insights on how context-aware technologies can be used in enhancing CDM amongst counter-terrorism organizations. Equally, the framework offers new understanding on the interaction of the different components in the CDM environment. Importantly, context-aware technologies are portrayed as important in the CDM environment and provide the actors (counter-terrorism and terrorists organizations) with mechanisms to improve on their current techniques either in inhibiting or promoting terrorist activities. Additionally, the framework illustrates the complex nature of attainment of CDM in complex-problem situations. This is because as shown in the framework, many intersecting factors need to be considered for the success of any collaborative activity.

Hence, in any collaborative activity, the involved actors need to know that many intertwining factors contribute to its overall success.

6.8 SUMMARY

In this Chapter, the CA-CDM framework has been proposed and its different part(s) discussed in detail. Additionally, an investigation on how context-aware technologies can be used in enhancing CDM has been illustrated. The proposed CA-CDM framework (Figure 6-1) is also evaluated using focus group interviews. From the focus group discussions adjustments were made to the initial proposed framework and the final CA-CDM framework presented (Figure 6-4). In the next Chapter a conclusion of the thesis is presented.

Chapter 7: Conclusions

7.1 INTRODUCTION

This Chapter provides the conclusions of this thesis. The Chapter is structured as follows: In Section 7.2 an overall summary of the thesis is given. In Section 7.3 a summary of the research methodology adopted is given. In Section 7.4 insights/reflection from the study is provide. In Section 7.5 the study's contribution to knowledge is presented. Limitations and recommendations for future studies are given in Section 7.6.

7.2 SUMMARY OF THE THESIS

The aim in this study was to determine how optimal/effective CDM could be realized amongst counter-terrorism organizations through the use of context-aware technologies (*main research question*). Thus, to achieve this objective a CA-CDM framework was developed. To develop the framework the process began with a study background, justification and rationale in Chapter 1. Equally, research objectives and questions that guided the study were also given in the same Chapter. The sub-research questions posed were:

- i. How can the terrorism problem be structured in the digital age?
- ii. What are the key factors influencing collaboration in decision making amongst stakeholders involved in counter-terrorism?
- iii. How can context-aware technologies be used in enhancing CDM amongst stakeholders involved in counter-terrorism?

In Chapter 2 a review of literature on Collaborative Decision Making (CDM), terrorism and context-awareness was undertaken. The analysis from Chapter 2 illustrated that CDM is a challenge, terrorism is a complex problem and context-aware technologies can be handy in enhancing collaboration amongst organizations involved in decision making. Theory of synergetics and institutional theory were adopted in the study (Chapter 2). Institutional theory was used in the study since it can be used to

understand how organizational/institutional environment influences organizational behavior (Scott, 2013). Theory of the synergetics was employed due to its ability to elaborate on and explain complex systems such as terrorism (Ebeling & Feistel, 2018). DSR methodology (Chapter 3) was employed in framework development.

In developing the framework, case study analysis and survey results were integrated with the findings in Chapter 2. The findings in Chapter 4 relied on the theory of synergetics and followed deductive thematic analysis. Using SSM approach, the elements from the word cloud (Figure 4-2) were re-categorized based on CATWOE analysis (Table 3-12) and using a rich picture (SSM step 2) the pivotal role of digital technologies in terrorism ecologies was portrayed (Figure 4-3). Through employing the components of the theory of synergetics (order parameters, control parameters, system elements, system constraints and environment) a conceptual model of Digital Terrorism Ecology (DTE) was developed (SSM step 4). The developed DTE comprised of open digital platforms, digital information ecosystem, digital terrorism enactment, digital capability and digital enslavement (

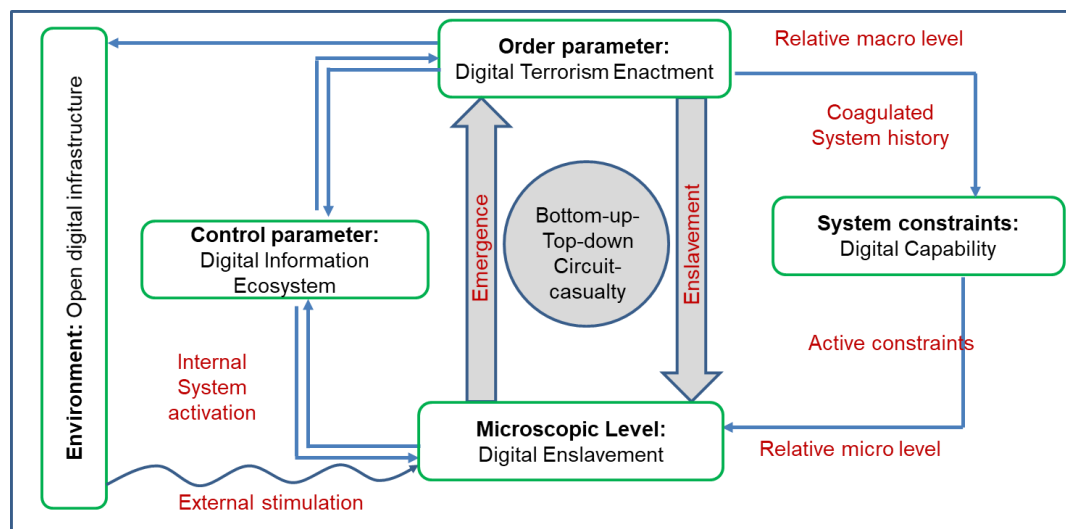


Figure 4-4). From the analysis in Chapter 4, the complex nature of the structure of terrorism and the role of digital technologies in terrorism was brought to the fore.

In Chapter 5, the factors influencing collaboration in decision making amongst counter-terrorism organizations was investigated. This was done through online and physical surveys using a structured questionnaire. Amongst the analyses performed were reliability analysis, Exploratory Factor Analysis (EFA) and PLS-SEM. Reliability analysis was performed to assess the internal consistency of the instrument since it had not been used/tested before. This was followed by EFA and finally, PLS-

SEM. PLS-SEM was adopted since it is good for modelling formative constructs in empirical studies to test hypotheses (Memon et al., 2017). Ten (10) hypotheses were tested in this study (Figure 5-4) using data collected from 176 respondents. From the 10 hypotheses, only 8 were supported in line with the three elements of institutional theory. Findings from this Chapter showed that organizational environment influences organizational behaviour which in turn impacts intra/inter organization(s) collaboration.

Relying on previous empirical frameworks and using results from Chapters 2, 4 and 5, a CA-CDM framework was proposed (Chapter 6). The different components of the proposed framework and their relationships were also discussed. The proposed CA-CDM framework was evaluated using focus group interviews and the results presented in the same Chapter. From the focus group discussions there was no deletion of any of the initially developed components of the proposed CA-CDM framework. However, there were suggestions to incorporate new components (e.g. community) within the framework and to introduce filters between some components (e.g. DTE and counter-terrorism organizations, community and counter-terrorism organizations) to filter corrupt information. After incorporating the suggestions from the focus group interview discussions, the final CA-CDM framework is given and thereafter in Chapter 7, the thesis concludes.

7.3 SUMMARY OF RESEARCH METHODOLOGY ADOPTED

In order to achieve the stated objectives in Chapter 1, a pragmatist view was followed and a mixed method approach undertaken. The pragmatist approach was adopted in the study because it draws heavily on inductive and deductive reasoning (Ihuah et al., 2013). Mixed method approach was used due to the nature of the problem under investigation (Mark et al., 2009).

DSR methodology was adopted since it supports the creation of artifacts (e.g. frameworks, model, an algorithm) to solve real-world problems (Kuechler & Vaishnavi, 2008; Offermann et al., 2010; Peffers et al., 2007; Winter, 2008). Peffer's et al., (2007) DSR process consisting of six steps namely; problem identification and motivation, define objectives of the solution, design and development, demonstration, evaluation and communication was adopted in this study (see Figure 7-1). The

contribution of each of the Chapters in this thesis to the implementation of the DSR process is also presented in Figure 7-1.

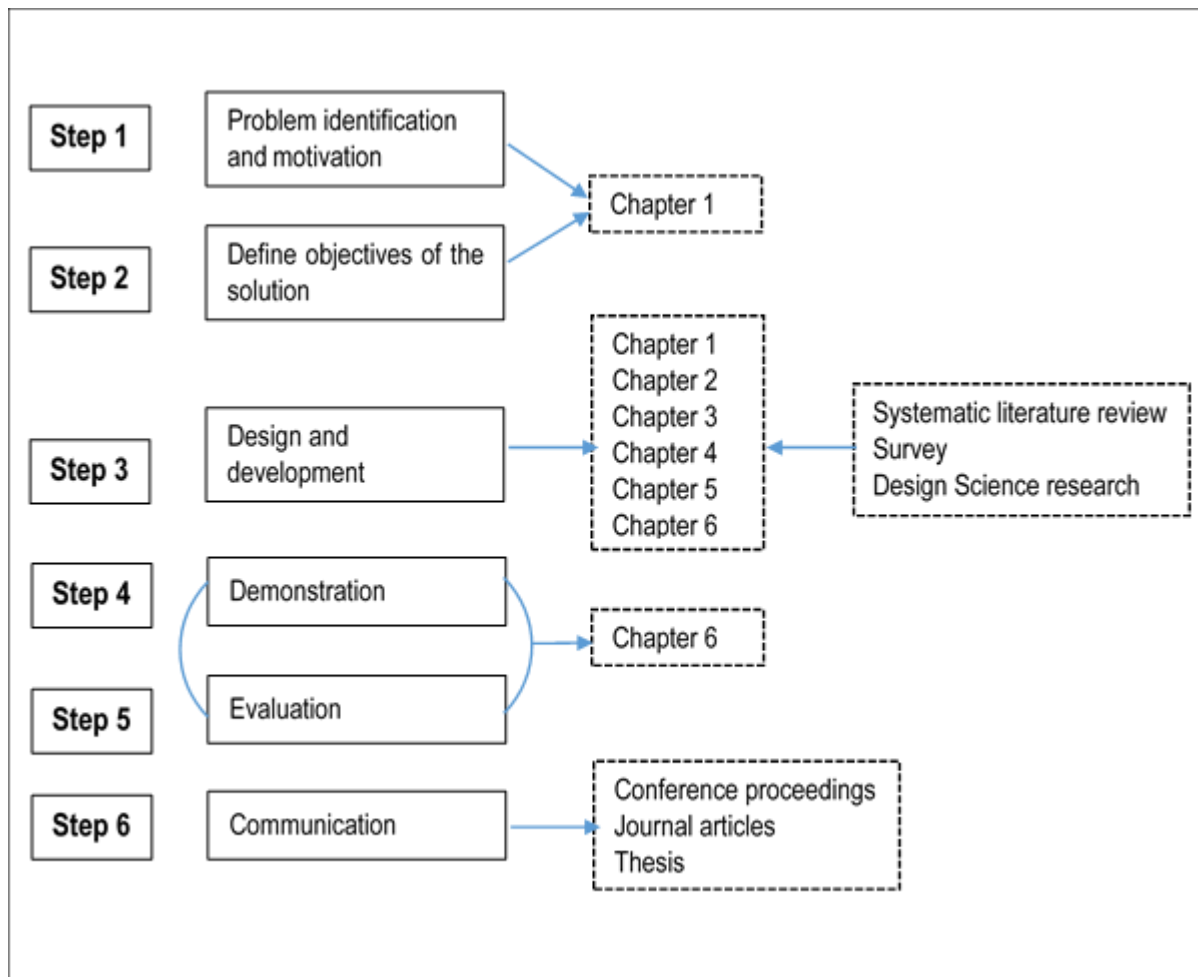


Figure 7-1: DRS methodology applied in this study

7.4 REFLECTIONS/INSIGHTS FROM THE STUDY

Several insights can be drawn from this study based on the research questions posed in Chapter 1 of this thesis.

From research question 1 (*how can the terrorism problem be structured in the digital age?*) among the insights that emerged were; (1) the complex nature of the terrorism problem and (2) the role of digital technologies in the modern age. The first insight that emerged was the complex nature of the terrorism problem. In this study, the complex nature of the terrorism problem is depicted by the multiple organizations involved in counter-terrorism, the varied definitions of the term terrorism and the different forms and modes of attacks of the terrorists etc. This is consistent with other

studies (Campedelli et al., 2018; Kittiyankajon & Chetchotsak, 2018; Roberts, 2015) where similar insights were drawn. Additionally, the role of digital technologies in terrorism has also been highlighted by this study. The affordances of these digital technologies were found to further complicate the terrorism problem to counter-terrorism organizations. An observation in line with that of (Odhiambo et al., 2018; Reuter, Pättsch, & Runft, 2017) who pointed out that in this digital age terrorism is constantly being redefined by digital technologies.

In addressing research question 2 (*what are the key factors influencing collaboration in decision making amongst stakeholders involved in counter-terrorism?*), the three elements of institutional theory (regulative, normative and cognitive-cultural) were found to influence inter/intra collaborative actions. Regulative elements may either promote or hinder attainment of effective/optimal CDM. For instance in cases where there is need for information to be shared due to regulative elements, there are protocols/ standards of practice that organizations must follow or else there will be consequences/sanctions. Normative elements can also influence CDM practices in instances where many organizations are involved. In collaborative practices, the organizations involved are many and varied in terms of the norms they abide by. For instance, a norm in organization A is not necessarily a norm in organization B. Cognitive-cultural elements may also hinder attainment of OCDM. For instance, information might be considered as classified in organization A but not in organization B. This may hinder information sharing. These findings concurs with the studies (Gil-Garcia & Sayogo, 2016; Nooshinfard & Nemati-Anaraki, 2014; Yang & Maxwell, 2011) that have also indicated that institutional theory elements greatly impacts inter/intra CDM.

The second insight from research question 2 was that organizational environment has a great impact on inter/intra collaborative practices. This is due to the regulations, procedures, and structures imposed on organisations by their organizational environments (DiMaggio & Powell, 1983; Dubey et al., 2018).

Unlike (Chatman & Barsade, 1995; Smith et al., 1995) that have pointed out that Organizational Form (OF) significantly influences Organizational Co-operation (OC), this is not the case in this study. This can be attributed to counter-terrorism being a security issue shrouded by loyalty, secrecy and privacy etc. (Glomseth, Gottschalk, & Solli-Saether, 2007) all of which might be toxic to inter/intra organizational co-

operation. Additionally, OC did not influence IKS an observation contrary to (Busuioc, 2016). This was also attributed to terrorism being a security issue.

The role of context-aware technologies in enhancing CDM amongst stakeholders involved in terrorism (research question 3) was also brought to the fore in this study via the developed CA-CDM framework. The framework offers new insights on how context-aware technologies (digital technologies) can be used in enhancing CDM amongst counter-terrorism organizations. Additionally, the framework offers new insights on the interaction of the different components in the CDM environment.

7.5 CONTRIBUTIONS TO KNOWLEDGE

The following are the contributions this study has to theory, to methodology and to practice.

7.5.1 Theoretically

This study contributes to knowledge by combining both the elements of theory of synergetics and institutional theory in developing a framework (CA-CDM). By combining the two theories, it was observed that CDM can be enhanced amongst counter-terrorism organizations through the use of context-aware technologies. The two theories adopted in this study have mainly been used in other fields. For instance, the theory of synergetics has been used in the natural science domain (physics, biology and chemistry) (Meynhardt et al., 2016) to understand and explain complex systems (Ebeling & Feistel, 2018; Liening et al., 2016; Odhiambo et al., 2018). In this study, the concepts of the theory of synergetics were used in structuring the terrorism problem in the digital age (*research sub-question 1*) in Chapter 4. This is because as presented in Chapters 2 and 4 terrorism is a complex problem and in order to meet the main objective in this study there was need to explore ideas on how similar problems have been investigated in other fields and hence the use of the theory of synergetics to come up with a new dimension (view), the Digital Terrorism Ecology (DTE). This is in line with Corley and Gioia (2011) and Whetten (1989) who stated that a potential contribution to theory should extend existing views or provide new points of views on the phenomena.

Institutional theory has been used in understanding and investigating how organizational environment influences organizational behavior (Biesenthal, Clegg,

Mahalingam, & Sankaran, 2018). However, in this study we have extended the applicability domain of institutional theory to complex problem situations i.e. CDM in the context of terrorism. This was done by identifying the factors influencing CDM amongst counter-terrorism organizations and development of a conceptual model (Chapter 5).

A survey of literature currently available reveals no studies that have employed institutional theory and theory of synergetics synergistically in complex problem situations. Hence, Chapters 4 and 5 of this thesis gives new insights on how two theories can be combined in complex problem situations. This is consistent to Corley and Gioia (2011) and Whetten (1989) who claimed that a theoretical contribution should show originality. Additionally, the applicability of the two theories extends our understanding and knowledge of usability of institutional theory and theory of synergetics (Corley & Gioia, 2011).

7.5.2 Methodologically

Methodologically, this current study has demonstrated the value of employing mixed method approach in investigating the phenomena of interest. By adopting mixed method approach in the study, the researcher was able to understand the phenomena of interest holistically and was able to find solutions to the *why*, *how* and *what* research questions (Ihuah et al., 2013). In other words, the mixed method approach provided more insights to the phenomenon of interest than a single methodology (qualitative or quantitative) would not have provided. The study also provided insights on how both SSM and deductive thematic analysis can be employed in problem investigation (Chapter 4). Using focus group interviews, a qualitative technique, the role of digital technologies (context-awareness) in enhancing CDM was demonstrated. Additionally, using surveys, a quantitative method, the researcher was able to identify the factors influencing collaboration in decision making amongst counter-terrorism organizations (Chapter 5). PLS-SEM was used to come up with a theoretical model depicting factors influencing collaboration in decision making. Further, in adopting DSR, the study demonstrates the efficacy of Peffer's DSR methodology in the development of the CA-CDM framework.

7.5.3 Practically

Practically, the study re-orientates the thinking of counter-terrorism organizations by presenting the socio-technical nature of the terrorism problem. This is done by explicating the role of digital technologies in terrorism and counter-terrorism strategies (Chapters 4 and 6). This study observed that, through digital technologies the terrorist organizations are able to recruit, train, spread propaganda and even instill fear. On the other hand, counter-terrorism organizations are also able to use digital technologies to freeze terrorist's accounts, monitor terrorist's activities online, and identify the terrorist's (Odhiambo et al., 2018). A synthesis of these findings leads to the establishment of the concept *Digital Terrorism Ecology (DTE)* which can be used in understanding terrorism in the digital age. This concept of DTE has five components; Open Digital Infrastructure (ODI), Digital Information Ecology (DIE), Digital Terrorism Enactment (DTE), Digital Capability and Digital Enslavement. All of which ought to be taken into account by counter-terrorism organizations in order to be able to prevent, combat or mitigate terrorism.

The study has also identified the challenges currently being experienced by counter-terrorism organizations in intra/inter organizational collaboration amongst these factors were: Organizational Form (OF), Technical Infrastructure and Interoperability (TI), Group/Departmental relationships (GDR), Organizational Cooperation (OC) and Information and Knowledge Sharing (IKS). From these factors a theoretical model showing the relationships has been developed. This developed model can be of great importance if used by organizations willing/planning to practice inter/intra organizational collaboration.

This study also underscores the need to exploit the functionalities of context aware systems such as sensing, thinking/processing and acting. *Sensing*- implies gathering of contextual information, *processing*- refers to employing reasoning techniques in order to obtain high-level contextual information (i.e. user's activities) and *acting*- is providing services to the user according to his/her current situation (Vahdat-Nejad et al., 2016). Within the context of this study, these functionalities of context-aware systems can facilitate CDM through information sharing (*sensing* e.g. through emails, Google hangouts, e-Calendar), using the processing capability of context-aware systems, counter-terrorism organizations can monitor terrorist's activities online, identify terrorists and monitor terrorist's movements physically (e.g.

CCTVs) and virtually (e.g. through trackers). After sensing and processing, these counter-organizations can now come up with targeted interventions based on sensing and processing functionalities (*acting*). It is this role of context-aware systems that informs the development of the CA-CDM framework that if adopted can be of importance to policy and decision makers in policies formulation and implementations concerning inter/intra CDM issues, especially amongst counter-terrorism organizations.

7.6 LIMITATIONS AND RECOMMENDATIONS FOR FUTURE

Just like any other study, the current research reported in this thesis was faced with certain limitations.

One of the limitations of the study arose from the survey component of the research in that, the variables used in the survey had not been either used or tested and were adopted, applied and tested for the first time in this study. The theorized relationship between optimal/effective collaborative decision making (OCDM) and CDM enablers (Organizational Form (OF), Technical Infrastructure and Inter-Operability (TI), Group/Departmental Relationships (GDR), Organizational Cooperation (OC), Information and Knowledge Sharing (IKS)) was also largely based on literature which suggested that CDM enablers significantly influenced OCDM in organizations. Additionally, the relationships as investigated in this study did not take into account the role of both the mediating and moderating variables in the theorized relationship. There is need for further studies that can shade light on the role of moderating and mediating variables on the theorized relationship as well as validating the theorized relationship in other contexts.

Another limitation was from the purposive sampling technique adopted which gave rise to research bias. This is because; purposive sampling may not always be representative of the populations under study. Additionally, the non-random (sampling) and cross-sectional nature (survey) of the current data suggests that the interpretation of results should be limited to the groups examined at the time of this research and therefore, the findings in this study can only be suggestive and hence, a good opportunity for future research where other sampling approaches can be explored. Despite the limitations above, this study present a first attempt at linking the relationship between OCDM and CDM enablers. Further, findings from the survey

components provide a useful starting point for studies in Information Systems, decision sciences, organizational studies, security studies amongst others, since the instrument was validated in a study by checking internal consistency, validity (e.g. face validity, content validity and construct validity) and conducting a pilot study.

The case of this study, terrorism, yielded another limitation due to its complexity as underscored in this research. The documents considered for the deductive thematic analysis (Chapter 4) covered terrorism literature post 9/11 to-date. However, the face, form and nature of terrorism keep morphing over time and hence the findings of this study ought to be integrated within the confines of this study. However, the analysis undertaken provided a snapshot of the complexity of the terrorism problem and the role of digital technologies in terrorism ecologies. Further research could provide more insights on the complexity and dynamic nature of the terrorism menace in the digital age.

Terrorism as presented in this study is a social construct, which although not discussed in this study since it's out of scope and is a suggestion for future research.

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Appendices

Appendix A: Initial Descriptive Nodes

NODES	NODES	NODES	NODES
Groups	Internet	Commission	Effectiveness
Public	Department	Communication	Hostage
Attacks	Members	Collaboration	ISIS
Political	Local	Citizens	Laws
National	Co-operation	Strategies	Policing
Enforcement	Network	Radicalization	Principles
www	Countries	Implementation	Ideology
Media	Rights	Legislation	Responsibility
Counter	Community	Governments	Environment
Social	Extremism	Al-Qaeda	Web
Rights	Muslim	Laundering	Propaganda
Intelligence	Domestic	Transnational	Politics
Agencies	Religion	Co-ordination	Twitter
Policies	Research	Governance	Trains
Organizations	University	Knowledge	Inter-agency
Counter-terrorism	Fire-arms	Trust	Shooting
Terrorists	Studies	Islam	Bombing
International	Regional	Goals	Kidnapping
Information	Society	Targeted	Rules
Police	System	Literature	Perspectives
State	Government	Cultural	Right
Criminals	Resources	Leadership	Act
Organized	Nations	Structure	Violently
Agency	Technology	Types	Operators
http	Weapons	Muslim	Governs
Border	Population	Relationship	Law
Approach	Authorities	Economic	Security
Support	Population	Force	Data
Issues			

Appendix B: Research Ethical Clearance: University of Venda

**RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR**

NAME OF RESEARCHER/INVESTIGATOR:

Ms NA Odhiambo

Student No:

18018329

PROJECT TITLE: A context-aware collaborative decision making framework for combating terrorism in Africa.

PROJECT NO: SMS/18/BIS/06/2007

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Prof NM Ochara	University of Venda	Promoter
Prof A Kadyamatimba	University of Venda	Co - Promoter
Ms NA Odhiambo	University of Venda	Investigator – Student

ISSUED BY:

UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE

Date Considered: July 2018

Decision by Ethical Clearance Committee Granted

Signature of Chairperson of the Committee:

Name of the Chairperson of the Committee: Senior Prof. G.E. Ekosse



UNIVERSITY OF VENDA DIRECTOR RESEARCH AND INNOVATION 2018 -07- 3 1 Private Bag X5050 Thohoyandou 0950
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University of Venda

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Appendix C: Research Approval Letter



NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: 020 400 7000,
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Fax: +254-20-318245,318249
Email: dg@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref. No. **NACOSTI/P/17/73101/20534**

Date: **11th December, 2017**

Nancy Achieng Odhiambo
University of Venda
SOUTH AFRICA.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on *“A context-aware collaborative decision making framework for combating terrorism”* I am pleased to inform you that you have been authorized to undertake research in **All Counties** for the period ending **11th December, 2018.**

You are advised to report to **the County Commissioners and the County Directors of Education, All Counties** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit a **copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

G.P. Kalerwa

GODFREY P. KALERWA MSc., MBA, MKIM
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioners
All Counties.

The County Directors of Education
All Counties.

National Commission for Science, Technology and Innovation is ISO9001:2008 Certified

Appendix D: Research Questionnaire



School of Management Sciences COVER LETTER

PART I: INTRODUCTION

Dear Sir/ Madam

My name is Nancy Achieng Odhiambo, a PhD student at the school of Management Sciences, University of Venda, South Africa under the supervision of Prof. Nixon Muganda Ochara and Prof. A. Kadymatimba. I am currently undertaking research concerned with how context-aware technologies can be used to enhance collaborative decision-making across and within organizations especially, those involved with terrorism related incidences. The title of my study is “A *context-aware collaborative decision making framework for combating terrorism in Africa*”. The objective of this study is to come-up with a framework that can aid in collaborative decision making with the help of context-aware technologies. Thus, the reason for conducting this survey is to get information that can assist in the development of the framework (*a context-aware collaborative decision making framework*). Results from this research could yield valuable information to individual organizations/institutions like yours on how they can deal with inter and intra agency collaborative decision making.

The information gathered during this study will remain confidential and will be treated with integrity. Participation is strictly voluntary, and you may decline to participate at any time. There will be no identification of either the respondents or organizations involved in the survey transcripts. Any potentially-identifying details will not be revealed in any publication that will result from this study. I am writing to request for your cooperation as I would be grateful if you could complete this short questionnaire.

Thank you for agreeing to participate in the study. Your input is greatly appreciated.

Yours Sincerely,



Nancy Achieng Odhiambo.

PART II: GENERAL QUESTIONS

Please respond to the questions by putting a tick mark (✓) at the choice that best describes your agency or organization

1. Which management level applies to you within your organization?

- Top management
 Middle management
 Operational level

PART III: Questions that pertain to the primary objectives of this study.

The following questions make use of the scale below. Please complete by circling one appropriate response for each question

Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5	6	7

#	Question	Ratings						
1. Information & Knowledge Sharing								
1.1	Information sharing is important to this organization	1	2	3	4	5	6	7
1.2	There is an information sharing policy in this organization	1	2	3	4	5	6	7
1.3	Members of the organization are adequately aware of the information sharing policies.	1	2	3	4	5	6	7
1.4	Staffing levels are adequate to provide quality services in this organization	1	2	3	4	5	6	7
1.5	Information sharing enhances accountability for decisions made in this organization	1	2	3	4	5	6	7
1.6	Information sharing enhances respect for organization's core values by its leaders	1	2	3	4	5	6	7
2. Organizational Form								
2.1	The structure of the organization enhances information sharing	1	2	3	4	5	6	7
2.2	The way this organization is structured promotes team work	1	2	3	4	5	6	7
2.3	Members of this organization fully understand each other's role	1	2	3	4	5	6	7
2.4	Inter-agency roles and responsibilities are clear in regards to security related issues.	1	2	3	4	5	6	7
2.5	There are set ethical standards that guide collaborative decision making between the departments	1	2	3	4	5	6	7
2.6	There are regular formal interactions with other departments of government	1	2	3	4	5	6	7
2.7	Decision making process is highly decentralized allowing for easy interactions	1	2	3	4	5	6	7
2.8	There are few direct inter-departmental and inter-branch interactions	1	2	3	4	5	6	7
2.9	All the branches pursue similar goals	1	2	3	4	5	6	7
3 Departmental/Group Relationships								
3.1	The communication frequency within the department enables attainment of goals	1	2	3	4	5	6	7
3.2	The communication frequency with other departments has influenced the effectiveness of goal attainment in this department	1	2	3	4	5	6	7
3.3	The department's values and beliefs promote mutual trust	1	2	3	4	5	6	7
3.4	The mutual trust amongst members in this department enhances the sharing of ideas	1	2	3	4	5	6	7
3.5	The mutual trust amongst other department and this organization enhances the sharing of ideas	1	2	3	4	5	6	7

3.6	Informal relationships are recognized in the department's policy and they tend to influence decision making	1	2	3	4	5	6	7
3.7	Informal relationships in this department influence collaborative decision making	1	2	3	4	5	6	7
3.8	Informal relationships between departmental cluster members influence collaborative decision making	1	2	3	4	5	6	7
3.9	The extent of "open" communication within the department influences collaborative decision making ("open"-transparent relations in terms of sharing ideas and resources)	1	2	3	4	5	6	7
4. Optimal Collaborative Decision Making								
4.1	Consensus building practices influence decision making in the department	1	2	3	4	5	6	7
4.2	The level of social interactions between departments/branches is adequate for enhanced collective intelligence	1	2	3	4	5	6	7
4.3	The department has adequate levels competence to carry out its mandate	1	2	3	4	5	6	7
4.4	The department relies on flexible and "open" knowledge resources in its decision-making process	1	2	3	4	5	6	7
4.5	Transparency in this department enhances collaborative decision making	1	2	3	4	5	6	7
5. Organizational Cooperation								
5.1	There is adequate participation in collaborative decision making at different levels in the department	1	2	3	4	5	6	7
5.2	At the cluster level, there is adequate participation of different departments/ministries in collaborative decision making	1	2	3	4	5	6	7
5.3	There are adequate conflict resolution mechanisms within the department resulting in increased collaboration in decision making.	1	2	3	4	5	6	7
5.4	There are adequate conflict resolution mechanisms that enhance the co-operation of different departments in collaborative decision making.	1	2	3	4	5	6	7
5.5	The leaders in this department foster a shared vision that enhances the co-operation of members in collaborative decision making.	1	2	3	4	5	6	7
5.6	The inter-departmental top leaders foster a shared vision that enhance inter-departmental co-operation in collaborative decision making.	1	2	3	4	5	6	7
6. Technical infrastructure & Inter-Operability								
6.1	The department has the needed Information & Communications Technology (ICT) infrastructure for delivering on its mandate	1	2	3	4	5	6	7
6.2	The department's Information & Communications Technology (ICT) infrastructure is responsive and reliable	1	2	3	4	5	6	7
6.3	There exists expertise for resolving technical challenges related to ICTs	1	2	3	4	5	6	7
6.4	There is continuous training for skills upgrading in this organization.	1	2	3	4	5	6	7
6.5	Connectivity between and within the branches of the department is seamless and easy (Inter-Operability)	1	2	3	4	5	6	7
6.6	The processes and procedures of the different branches of the department are integrated	1	2	3	4	5	6	7
6.7	The service delivery processes and procedures of the different branches of the department are standardized		2	3	4	5	6	7

Appendix E: Focus Group Guide



School of Management Sciences

Title of the Study: *A context -Aware Collaborative Decision Making Framework for Combating Terrorism in Africa*

PART I: INTRODUCTION TO THE RESEARCH

My name is Nancy Achieng Odhiambo, a PhD student in the School of Management Sciences University of Venda under the supervision of Prof Nixon Muganda Ochara and Prof A. Kadyamatimba. I am currently undertaking a research study on how context-aware technologies can be used to enhance collaborative decision making amongst the stakeholders involved with terrorism related acts before, during or after. The aim of this research study is to come up with a framework (CDM) aided by context-aware technologies.

The information I will gather will be used to evaluate the developed CA-CDM framework. Please be assured that ethics issues are very important in this study and therefore, nothing will be linked back to the respondents. The interview session should take at most 30 minutes.

To the researcher, there is no wrong answers, so please be as open and honest as possible with your opinions and views. Because you are in a group, you will hear each other's views; let's agree that everything said in this room stay confidential between the group members.

This is the developed framework (Please project it)

lead into outcomes both within (rectangle 2) and outside (in the CDM environment).

PART II: DEMOGRAPHICS

Date of interview	
Time of interview	
Venue of the interview	
Duration of the interview (hrs)	

Current position/Role in the organisation	
Number of years in the organisation	

PART III: QUESTIONS

QUESTIONS
1. Is there any part of the framework that you do not understand?
2. Are the suggested interactions between the part(s) of the framework valid?
3. Is the role of technology (digital technologies) within the framework captured sufficiently? Why?
4. Do you think the actors (counter-terrorism agencies) as depicted within the framework can sufficiently carry out their required tasks using digital technologies within the framework?
5. Based on the framework do you think digital technologies can work for or against counter-terrorism efforts? Why?
6. Do you have additional suggestions that can improve the framework as it?

PART IV: THANKS FOR YOUR TIME