DEVELOPING A STRATEGIC FRAMEWORK TO ENHANCE READINESS OF UAE LAW ENFORCEMENT AGENCIES TO EFFECTIVELY RESPOND TO ROAD TRAFFIC EMERGENCIES

EBRAHIM HASAN ALZAABI

Supervised by

PROFESSOR ZEESHAN AZIZ

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ABSTRACT

The high number of road traffic accidents and increasing prevalence of road traffic crises around the world has brought to the fore the need for a higher level of crisis preparedness and response. In the UAE, crisis response times are significantly below target levels with performance gaps in crisis response areas. Within extant literature, there is a lack of understanding or frameworks that guides the development of effective road traffic crisis readiness programmes, identifying key dimensions and measures for optimising response times. There is a need for decision support frameworks specific to road traffic crises, that prioritise and define key performance criteria and measures across all dimensions focused on readiness and response.

The scope of this study is focused on developing a crisis readiness framework for road traffic crisis response for law enforcement agencies in the UAE. The goal is to enhance the organisational effectiveness of law enforcement agencies within the UAE to effectively respond to road traffic crisis situations and disasters. A key research question is: What strategic framework is appropriate to enable the development of strategies and performance indicators to enhance response times of police to road traffic crises? To answer this question, a Delphi Method was utilised that combined questionnaire-based survey and the Analytical Hierarchy Process (AHP) to collect quantitative and qualitative data, from an expert panel of 16 experienced crisis readiness professionals, on how they prioritise and weight the different strategic criteria, sub-criteria and performance indicators in the context of law enforcement agencies' traffic response. The findings resulted in the identification, ranking and validation of ten key dimensions of crisis readiness clustered into 3 distinct sets of priority rankings: Response Planning, Resources, Training, and Coordination; Information Management and Communication and Risk and Hazard Assessment; Early Warning, Legal and Institutional Frameworks, Recovery Initiation and Property Protection. The results additionally established the relative priority of sub-criteria for each criterion and validated a broad set of KPIs for the top six ranked criteria. A secondary focus was to investigate the barriers that obstruct the development and implementation of UAE's performance indicators. The findings from primary qualitative and secondary data suggested a number of antecedents associated with inter-organisational, structural and national cultural factors which impact on the efficiency and effectiveness of the existing approach to crisis readiness.

This research makes a contribution to knowledge in identifying the key criteria and performance indicators of crisis readiness for road traffic situations. The findings contribute a comprehensive strategic readiness framework that supports planning and decision-making for the development of organisational capacities that can enhance response times of police to road traffic crises. A management tool is advanced to structure the planning and evaluation of crisis readiness programmes and the development of future strategies around critical dimensions and factors. This framework ranks dimensions of crisis readiness and key sub-criteria in order of priority and relative importance. This model validates the key components of crisis readiness that can support practitioners to structure, standardise and benchmark key processes and elements of crisis response and can direct efforts to optimise different dimensions of crisis readiness at a strategic and operational level.

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AHP	Analytical Hierarchy Process
CAR	Capability Assessment for Readiness
CDGC	Civil Defence General Command
COP	Central Operation Centre
CR	Crisis Readiness
CP	Crisis Preparedness
CSPD	Corporate Strategy and Performance Department
DT	Department of Transport
DM	Disaster Management
EM	Emergency Management
EMA	Emergency Management Australia
EP	Emergency Preparedness
EWS	Early Warning System
FANR	Federal Authority for Nuclear Regulation
FEMA	Federal Emergency Management Agency
FTA	Federal Transport Authority
GIS	Geographic Information System
GPS	Global Positioning System
IAEM	International Association of Emergency Managers
IASC	Inter-Agency Standing Committee
IMC	Information Management and Communication
KPI	Key Performance Indicator
LFA	Lead Federal Agency
LLA	Lead Local Agency
MIC	Monitoring Information Centre
MOEW	Ministry of Environment and Water
MOH	Ministry of Health
MOI	Ministry of Interior
MPRR	Mitigation, Preparedness, Response and Recovery
NCEMA	National Emergency, Crises and Disasters Management Authority
NCM	National Center of Meteorology

NES	National Enquiry System
NRA	National Risk Assessment
NIMS	National Incident Management System
NOC	National Operations Centre
NRF	National Response Framework
NRP	National Response Plan
NRR	National Risks Register
NRS	National Response System
OECD	Organisation for Economic Co-operation and Development
OHSMS	UAE Occupational Health and Safety Management System
RA	Risk Assessment
RMI	Risk Management Index
RPG	Recovery Planning Group
SA	Support Agencies
UAE	United Arab Emirates
UN	United Nations
USAID	United States Agency International Development
WHO	World Health Organisation

CHAPTER 1: RESEARCH INTRODUCTION

1.1 Introduction

Around the world environmental and human factors increasingly represent a source of risk, that can lead to crisis situations on road networks. When a crisis occurs on roads, the degree of readiness of the relevant national, regional or local authorities is a critical human factor (Alexander, 2015). Crises and disasters have historically been an ever-present aspect of everyday society (Dranseika and Gordijn, 2018). The likelihood of road traffic crises is a function of human and social behaviour and the environment. Society is currently subject to increasing volatility and widespread risks arising from political, environmental, technological or social events that can result in significant human, physical, economic or environmental loss. Road traffic incidents have become a major phenomenon around the world reaching 1.35m deaths annually (WHO, 2020). Arab Countries have the highest global levels of road traffic fatality of between 18-28 fatalities per 100,000 inhabitants compared to 4.5 in European countries (WHO, 2020). Many causes can be linked to changes in the global ecological system, rapid urbanisation, and human behaviour that have accelerated and increased the severity of road traffic events (Perrow, 2011). These events have consistently underlined the need for strong resilience and readiness capabilities to ensure the ability to effectively respond, alleviate and contain the impacts of road crises or disaster events (Boin et al., 2016).

In the United Arab Emirates (UAE), different factors have contributed to increasing potential for road traffic crisis, and the lack of a comprehensive framework for evaluating crisis readiness underlines the core motivation for this research (Alteneiji, 2015; Al-Marzooqi et al., 2017). Across all fields and contexts the need is identified for comprehensive frameworks and valid indicators to support the development and evaluation of road crisis readiness and resilience systems. The increasing risk of road traffic crises have brought to the fore the need for better resilience and response (Dranseika and Gordijn, 2018), resulting in increased recognition and pressure to ensure a high level of crisis preparedness. The significance of readiness for crises and disaster is underscored by the unpredictability and minimal window of time to respond. While there is growing international co-operation and co-ordination for major interventions and overarching frameworks that address major events, development of readiness capabilities

at national and institutional levels for road traffic crises has yet to be addressed. Various scholars have emphasised that the size and scope of crises is rapidly increasing (Boin et al., 2016; Farazmand, 2017). Nevertheless, research shows that crisis readiness persists at a low level and is generally not well understood (Paton, 2003; Light, 2005).

The term crisis is often used interchangeably with terms such as disaster or emergency, yet it represents a distinct notion within this research. A crisis can be defined as "an unstable time or state of affairs in which a decisive change is impending – either one with the distinct possibility of a highly undesirable outcome or one with the distinct possibility of a highly desirable and extremely positive outcome" (Fink, 1986, p.15). Different definitions and classifications of the concept crisis emphasise numerous facets that suggest a criteria of crisis readiness in terms of development of capabilities that account for the uncertainty, ambiguity, insecurity, and complexity of crises; different types and levels of severity; and urgency and rapidity of decision-making and response (James and Wooten, 2005; Nohrstedt et al., 2018; OED, 2018). Consistently within the literature is the notion of crisis as an unstable and evolving phenomenon that has the potential to grow and develop and lead to serious negative impacts and loss of life or destruction (Pearson and Clair, 1998; James and Wooten, 2005; Nohrstedt et al., 2018; OED, 2018).

The concept of road traffic crisis draws on these same facets of general notions of crisis but emphasises an unstable time or situation on any part of the road transport network with a distinct likelihood of serious negative impacts and loss of life or destruction of property and environment and requiring a decisive rapid response. Road traffic crises represent a specific context in which a crisis can occur. Any of the conditions that characterise broader crises and disasters such as earthquakes, wildfires, or chemical spills can also incite or influence the occurrence of a road traffic crisis. While road traffic incidents are a common impact on the safety and capacity of road systems (Easyway, 2011), road traffic crisis situations are complex, unstable and unpredictable, with responses implemented under conditions of significant uncertainty, intense time pressures, and entailing the cooperation of multiple different professional groups (Comfort and Kapucu, 2006; Lee et al., 2011). Crises in road traffic may also be viewed in terms of a failure in critical infrastructure that comprises road systems and road

transport. Such failure can have impacts on energy, health and other sectors (Rehak et al., 2019).

Road traffic is one of the major implications of urbanisation and population growth. Human development heightens the risk of crisis situations on the roads around the world. A key driver is population growth resulting in increasing number of cars. Global population levels have increased to over 7.5 billion people (USGov, 2020) and approximately 55% live in urban areas due to factors such as greater facilities and employment opportunities (UN, 2018). Some evidence points to a direct and proportionate relation between population growth and increasing risks and hazards (Coppola, 2010; Collins et al., 2014). This implies that future road traffic crises will only increase in both occurrence and complexity. These trends are associated with greater intensity of production and transportation and increasing travel behaviour in terms of more journeys over longer distances. Unrestricted growth in cities and urban areas is increasingly viewed as a challenge which can negatively impact on social, economic and environmental quality in terms of air pollution, longer travel times and greater risk of road accidents and incidents (Steenbruggen et al., 2012a). Perrow (2011) asserted that growing technological sophistication and close coupling of events and effects has resulted in an increasing likelihood and normalisation of accidents and crises. Rosenthal and Kouzmin (1997) have similarly suggested that greater complexity, interdependence and vulnerability within technological systems results in more problematic and unintended consequences. These trends are argued to have been intensified by globalisation and the rapid movement of goods and people around the globe, which in turn makes technological and communication systems not only more complex but also more indispensable (Sternberg, 2017).

This context emphasises the heightened risk for road traffic crises and underscores an increasing trend in road traffic incidents that has become a major phenomenon around the world reaching 1.35m deaths annually (WHO, 2020). Arab countries have some of the highest levels of road traffic fatality globally (WHO, 2020) therefore response time is a key measure and a reflection of the preparedness and readiness of society and organisations to crisis events. The central focus of this study is to enhance the organisational effectiveness of law enforcement agencies within the United Arab

Emirates (UAE) to effectively respond to road traffic crisis situations and disasters. UAE law enforcement agencies are a key unit of analysis for this study. The first section of this chapter introduces this research context and outlines the background to the study and the research problem and challenges faced within the specific context. The second part describes the purpose of the research and states the research questions and objectives. The final sections of this chapter provide a summary of the research methodology, research rationale and outline of the overall thesis structure.

1.2 Research Context

1.2.1 Background to the Study

Road transport networks represent major arteries at the heart of the social system which can easily be impacted by a wide range of natural and man-made disasters and present major challenge for the crisis readiness of police traffic divisions. The social and environmental context in the UAE has created greater exposure to a diverse range of hazards and situations that have significant implications for road traffic related crises and police response times.

Firstly, in context of road safety within UAE, the severity of road traffic incidents and the potential of crisis situations is influenced by increasing environmental volatility in terms of tsunamis, flooding, dust and sandstorms and cyclones and the effects of climate (e.g. Fog, flash floods, heavy rains) (Dhanhani et al., 2010). Such environmental factors create an increasing risk dimension that have the potential to create highly complex and unstable road crisis situations with potential significant loss of life or destruction. Over the last 20 years the country has witnessed a number of natural disasters including the Al Qurayah flood in 1995, Masafi earthquake in 2002, and the Sharm flash flood in 2009. Sandstorms and landslides in areas located in higher altitudes are a common occurrence (Emirates 24/7, 2016) while the UAE's east coast is at risk of tsunamis as it is close to the seismically active Makran region (Al-Khaili, 2015). New natural vulnerabilities have implications for road safety after growing seismic activity in the country as a result of its location on different plate boundaries colliding along the Bitlis and Zagros belts (Almarzouqi, 2017). Any unexpected or sudden movements have the potential to lead to road crisis situations. Rising sea levels are another example of heighted risk to road systems for the UAE. Data shows that the smallest rise in sea levels could submerge

between 1% and 6% of the total national land area (UAE Second National Communication, 2010). Moreover, the UAE is likely to experience more extreme weather events such as prolonged and intensive storms or heatwaves (UAE Second National Communication, 2010).

In addition to abovementioned dimensions of risk, specific issues exist in relation to the road traffic emergencies in the UAE. The frequency of accidents has been declared a national disaster by the UAE government (Bener and Crundall, 2005). As traffic on the UAE's roads has steadily increased, there has been a concomitant rise in road traffic accidents (Al Ramahi, 2017). Road fatalities are the second largest cause of death in the UAE after heart disease (DoT, 2018) as well as one of the leading causes of mortality amongst children (UAEGov, 2020). The UAE has one of the highest rates of ownership of luxury and high performance cars in the world (Shingetsu, 2020) and one of the worst records in terms of seatbelt safety (RoadSafetyUAE, 2018). Fatality rates are three times those in the UK at 7.95 deaths per 100,000 inhabitants in 2016, a rise of 7.4% over 2015 (RoadSafetyUAE, 2018).

This context of environmental and human behaviour has the potential to interact and create potential for different types and severity of road crisis situations. While the extent to which road traffic crisis situations can be prevented is one factor, crisis readiness to respond effectively and efficiently is a critical dimension to help to reduce the loss of life and minimise physical destruction (Fagel, 2013). The issue of road safety addresses the strategic goal to reduce the number of road deaths to zero by 2030 (Al Ramahi, 2017). This presents a challenging and complex context for law enforcement and a requirement for much higher levels of responsiveness in preparing for and responding to road traffic crises associated with diverse and dynamic factors.

1.2.2 Problem Statement

To address the abovementioned road safety issues, the long-term policy goal to reduce the number of road deaths to zero by 2030 has been set in the UAE (Al Ramahi, 2017). Yet, while crisis management theory and practice have contributed a significant body of knowledge in all areas of crisis management, there is a lack of balanced attention both in theory and practice in the area of emergencies on roads of strategic importance. Governments often do not possess strategic management capacity to focus on all four

phases of disaster management: mitigation, planning and preparedness, response, and recovery (McGuire and Schneck, 2010).

While the UAE has made significant efforts to improve its crisis readiness, the increasing diversity, frequency and scale of crises that are and can affect the population are placing increasing pressure on government and inter-agency resources and challenging capabilities for effective response (Al-Marzooqi et al., 2017). Some crises have immediate impacts while other crises have medium to long-term effects. In the UAE, the increase in frequency and severity of road traffic accidents (Ankit et al., 2018) means that the economic cost alone of road traffic accidents can equal as much as 2-3% of annual GDP (Haj Ahmed, 2002; Hassan et al., 2012).

The perception that crises are increasing has developed in tandem with the belief that the pace of change in society and within organisations is accelerating (Farazmand, 2017). Fuerth (2007) argues that contemporary emergent problems belong in a different class to conventional issues as they are no longer hierarchical but highly complex in structure and dynamics and unstable and rapidly changing. The extent that trends and events interact spontaneously and in a fast-moving way is suggested to outpace the capabilities of societies to respond. Within such complex systems Fuerth (2007) characterises the inputs and outputs as at the very least unpredictable and in some cases significantly non-linear, so that small events may result in substantial consequences or impacts.

Thus, the ability to respond to crises is increasingly dependent on an integrated, coherent and multidimensional approach among a broad range of actors including government, civil society, the private sector and international agencies. Effective coordination between crisis response agencies can optimise crisis response efforts and save resources, time and most importantly the lives of residents (OCHA, 2016). In the UAE recent responses to crises revealed that effective coordination is hampered by an absence of appropriate policies and mechanisms and understanding of how coordination can be optimised (Alteneiji, 2015). In particular enhancing coordination between federal and local levels during the management of disasters is a major need (Alteneiji, 2015; Al-Marzooqi et al., 2017; Almarzouqi, 2017). While NCEMA is the federal level authority charged with crisis management during disasters some overlap has been noted in relation to how prevention, preparedness and recovery efforts are coordinated with the police

force which clearly assume a central role in leading responses and managing crises and disasters. Duplication of roles, communication gaps, and speed of response are identified as key issues (Al-Marzooqi et al., 2017). Greater optimisation in this area could positively influence the adoption of a more holistic approach to crisis readiness and response that links international, regional, national and local level initiatives to enhance preparedness (UN, 2008).

Specifically, response times to crisis communication are a critical part of effective crisis readiness and response. Key national indicators for the UAE place focus on optimising the response times of emergency services to crises to 4 minutes by 2021. However despite consistent reductions in average annual response times over the previous three years there remains a wide gap between current practice and the national target. Internal data from the UAE Ministry of Interior shows that five key areas in the crisis communication process are identified for improvement to enhance the overall response time (UAE, 2017). While performance in 2015 shows that the first reporting stage is outperforming the target response time there is a performance gap in the remaining four stages of receiving the communication, sending, dispatch, and accessing and closing the file. Optimisation requirements therefore suggest that an overall reduction of 12.44 minutes from the 2015 average crisis communication response time is required to achieve the 2021 target (UAE, 2017).

Public education and communication in relation to disasters or emergencies are key parts of crisis readiness and response and police roles. Timely and accurate communication of information is directly correlated to the fatalities, suffering and fear, panic and suspicion before and during a crisis event (WHO, 2010). In the UAE some evidence points to under-optimisation of communication performance and need for development to enhance readiness capabilities in the UAE (Al-Marzooqi et al., 2017). Problems in communication with the public have been a feature in previous UAE disasters (Al-Marzooqi et al., 2017). More specifically a strategic gap is acknowledged in the requirement for development of a national strategic plan for public education and communication on crisis risks and events (Alteneiji, 2015). Recent evidence shows that there is a lack of procedural knowledge among agencies in relation to early warning communication and members of the community are unaware and uninformed of Federal

plans (Al Hmoudi and Aziz, 2015). Moreover, the unique context of the UAE presents challenges for education and communication in terms of cultural and language barriers. The UAE is home to over 200 nationalities that implies significant population diversity. Many among the large expatriate population do not speak Arabic and the presence of a wide range of languages from English, Farsi, Hindi and Urdu generate substantial communication challenges (Al Hmoudi and Aziz, 2015; Alteneiji, 2015). Al Ameri (2010) identifies that in the transfer of understandable warning messages and preparedness information to those at risk in the UAE there is substantial scope for improvement to address all residents' needs. Sensitivity is needed in crisis communications to the multicultural character of the population (Alteneiji, 2015; Al-Marzooqi et al., 2017).

The issue of the development of a strategic framework for improving response times to road crises can be stated in terms of training and development. This dimension is a critical measure of the effectiveness of crisis readiness and response which requires skilled people at all levels and among all stakeholders with a clear understanding of their role in the process (UN, 2008). In crisis situations police officers draw on their training and capitalise on their knowledge in preparing and responding to a crisis (Hilton, 2017). The UAE experience suggests several challenges in this area which could undermine the ability to effectively prepare for and respond to crises. Successful capacity development in crisis readiness is founded on the generation of dialogue and learning between all actors within the crisis management system to support improvements over time (UN, 2008). Evidence shows that in the UAE there is significant scope for optimisation of mechanisms and processes which would facilitate the sharing of crisis readiness knowledge and experiences (Al-Marzooqi et al., 2017). Minimal opportunities are identified to exist for informal exchange and dialogue among key actors in crisis management systems (Al-Marzooqi et al., 2017). Cultural influences in the UAE may further constrain effective dialogue among agencies and stakeholders. Evidence suggests that the hierarchical and collectivist character of Arabic culture may influence a reluctance to share knowledge and information between individuals and across organisations (Hofstede, 1991; Biygautane and Al-Yahya, 2011). This draws on a deep-seated cultural emphasis on trust, strong social networks, 'wasta' or strengthening the effect of personal connections, status, and informal communications (Al-Esia and Skok, 2014; Asrar-ul-Haq and Anwar, 2016).

In this context knowledge is viewed to be a ‘power’ shared for personal advantage in terms of influence or status (Seba et al., 2012; Al-Esia and Skok, 2014) and therefore promarily engaged in when beneficial for the knowledge-holder.

Further challenges have been identified in strengthening capacities at the local level (Al-Marzooqi et al., 2017). Evidence suggests however that minimal ongoing training at this level and in conjunction with communities is conducted in the UAE that can enhance individual and group skills to cope with different types of crises (Alteneiji, 2015; Al Hmoudi and Aziz, 2015; Al Ruwaithi, 2019). In particular there is minimal community engagement in disaster planning and response among a demographically imbalanced population of which 88% comprises immigrant workers (Al Ruwaithi, 2019).

Moreover, within the current system there are challenges in relation to clear definition of performance indicators and strategic framework for crisis readiness. This is hampering initiatives to address identified needs for service and operational improvements (UAE, 2017). This challenges the monitoring and assessment of law enforcement performance at the macro level while assessment of individual performances within an organisation are made more complex by the difficulty in aligning individual performances and organisational goals. Compounding the issue there is a current lack of knowledge and understanding on high-level performance indicators within the UAE to monitor readiness and capability of law enforcement agencies to respond to crisis and disaster situations.

These issues underline the need for a strategic framework and clearly defined performance indicators to support effective response to crisis and disaster situations and to evaluate the readiness of individual law enforcement units to respond to road traffic crises. An established and clearly defined framework could provide agencies a holistic model to enhance their performance beyond immediate crime prevention to ensure effective readiness for crisis and disaster situations.

1.3 Research Rationale

The preceding problem context provides significant imperative for crisis readiness and the associated capabilities to respond and mitigate negative impacts and prevent escalation. Road traffic incidents have significant economic and social cost. Globally, road traffic death is the single leading cause of fatality of young people between 5-29

years of age. Data shows that road traffic crashes cost economies nearly 3% of gross domestic product (GDP) annually, and more than 90% of road traffic deaths occur in low and middle-income countries (WHO, 2020).

There is a need for a comprehensive crisis readiness and response framework that defines the key criteria and performance indicators at a local or agency level. A systematic review of the literature in this field between 1986-2020 firstly shows that much of the research on road traffic incidents and safety is concentrated firstly on emergency management, emergency or disaster response addressing a diverse range of specific issues such as routing optimisation, decision-making algorithms or vehicular response. Some studies address road traffic incidents from the broader perspective of crisis management focused predominantly on decision-making frameworks. The concept of crisis readiness is addressed by only a handful of studies in this period and focused predominantly on route or model optimisation solutions. Meanwhile the notion of road crisis has been addressed by a small number of studies focusing on disaster management, emergency management or disaster response and addressing road network analysis, decision-making platforms, Internet of things and social media. Most notably, the knowledge gap is characterised by a lack of research into a broad conceptualisation of crisis readiness for road traffic crisis situations. Extensive review shows that while many studies address a plethora of topics on road safety that identify numerous key elements for disaster or crisis situations, no study has yet comprehensively identified and prioritised within a single model or framework the critical factors of crisis readiness.

While disaster resilience and crisis management are identified as significant mechanisms to reduce the adverse effects (Cutter et al., 2010), there is further opportunity for the development of specific indicators that will support the development and evaluation of crisis readiness. Operational resilience indicators have yet to be explored, because resilience has to be built across different disciplines (Carpenter et al., 2005). However, as suggested by Pelling (2004), disaster risk indexing is increasingly becoming an important tool to improve the effectiveness and transparency of disaster management (Pelling, 2004). In this context, indicators denote metrics obtained from data which identifies direct and indirect drivers of natural and man-made hazards in the future and at present (De Sherbinin, 2014). Indices are aggregated indicators and inform about high-

priority matters by weighing issues (De Sherbinin, 2014). Carreno et al., 2007 also explain that a risk management index (RMI) uses various indicators in order to assess risk management performance and the effectiveness of the disaster risk management system. These indicators are predetermined benchmarks and targets, which clarify the goals of the risk management system. They therefore create a ranking system of achievements, help identify gaps and assist with measuring resilience to hazards (Carreno et al., 2007). Other disaster resilience indicators have also been formulated by national and international aid agencies (USAID, 2013). These indexing projects generally employ disaster causality theory and assume that firstly being exposed to hazards, secondly severe or frequent hazards, and thirdly vulnerability to exposure, are all factors which cause losses (Pelling, 2004).

Research to date has contributed national level frameworks that address broad contexts of major disasters. Consequently, there is a lack of understanding and identification of factors and the development of a comprehensive framework that defines critical mechanisms and processes that can be applied for the development and enhancement of the crisis readiness of road traffic agencies. There is further research challenge in understanding the impact of modern technologies such as social media, big data, data-mining, artificial intelligence, machine learning, simulation and modelling to enhance the efficiency and effectiveness of crisis readiness. While the disruptive potential is widely discussed few studies have examined the roles or the planning and integration of new technologies to address different dimensions of crisis readiness and response.

There exist gaps in multiple dimensions of crisis readiness that merit further investigation. Risk assessment is one critical element where a further specific framework is required to ensure comprehensive understanding of the relationship between crisis response and risk management in terms of effectiveness of identification and evaluation of risks and hazards (Carpenter et al., 2005). Across many dimensions there is a requirement to apply a systematic and robust framework and indicators that enhance resilience in disaster preparedness and response in terms of training, early warning systems, infrastructure and resources. De Sherbinin (2014) argues that more research is required to assess how indicators influence policy and are used by relevant parties. Further, there is a gap in understanding strategic crisis readiness and response frameworks

in specific contexts such as police road traffic crises. Therefore this research is situated in the UAE context focused specifically on road traffic response times of law enforcement.

This research makes a significant contribution to both academic and practical fields. The findings contribute a comprehensive strategic readiness framework that supports strategic planning and decision-making for the development of organisational capacities that can enhance response times of police to road traffic crises. The framework makes a contribution in defining key components and implementation factors for improving crisis readiness in agencies involved in road traffic crisis response in the UAE. Further the study provides a contribution in presenting a framework of key performance indicators (KPI) that can be used to benchmark and evaluate practices and processes of the traffic and patrols directorate in the Abu Dhabi and Dubai police sector and other emergency sectors such as rescue and firefighting, ambulance and civil defense. In developing countries, and particularly in the UAE, there is a shortage of empirical studies regarding the adoption of KPIs. Addressing the gap in the literature in developing countries is the main contribution of this research. A contribution is made to the area of KPI knowledge through the systematic identification and prioritisation of key processes that can be developed and evaluated in the specific context of police road divisions to enhance crisis response and support continuous strategic and tactical development.

1.4 Research Questions

The research context and problems outlined above gives rise to a number of research questions that guide the focus of this investigation:

1. What are the existing strategies and practices for crisis readiness and response for Police in the UAE?
2. What factors and elements of crisis readiness based on theory and practices are critical for the specific context of improving response times to road traffic crisis in the UAE?
3. What are the perspectives of practitioners of crisis readiness of the police and how do they prioritise and weight the different strategic factors and performance indicators?

4. What are the barriers that obstruct the development and implementation of UAE's performance indicators, focused on law enforcement participation within UAE road crises situations?
5. What strategic framework can be proposed that will enable the development of strategies and performance indicators to enhance response times of police to road traffic crises?

1.5 Research Purpose

1.5.1 Research Aims

The primary aim of this study is to investigate crisis readiness and response of Police in the UAE and develop a strategic framework that supports readiness and response planning to improve Police response times to road traffic crises.

1.5.2 Research Objectives

This study focuses on six objectives to address the research questions and goals of this research:

1. To evaluate crisis readiness and response strategies and performance of police to road traffic crisis.
2. To identify the barriers that impact on the role of law enforcement agencies within traffic crisis situations.
3. To identify factors and key performance indicators that are critical for improving crisis readiness and response times of road traffic police divisions.
4. To develop a strategic framework for police crisis readiness that defines key factors and performance indicators that enhance response times for Police road traffic crisis situations.
5. To validate the strategic framework by conducting a systematic measurement and evaluation process to prioritise and weight the different strategic factors and performance indicators.
6. To produce recommendations and guidelines for law enforcement agencies focused on enhancing road traffic response times for crises and disaster situations within the UAE.

1.6 Outline Method

This research adopts a pragmatist mixed-method approach that integrates both quantitative and qualitative data. An inductive approach is pursued with the purpose of establishing an in-depth understanding of the specific research context of crisis readiness and response in law enforcement. The mixed method approach is incorporated within a single holistic case study design focused on the Police road traffic context in the UAE. This research employs the Delphi Method as the primary data collection mechanism to gather qualitative and quantitative data. Questionnaire methods and the Analytical Hierarchy Process (AHP) are integrated into the Delphi method to complete the research design. The Analytical Hierarchical Process (AHP) is a comprehensive framework which will enforce a systematic process to generate multi-objective, multi-factor and multi-criteria decision-making for the development and validation of a crisis readiness framework.

1.7 Thesis Structure

This thesis presents the findings of an investigation into enhancing the crisis readiness and response of the UAE police to road traffic crises. Chapter 1 has introduced the study background and problem context, the research aims and objectives, and the research methodology underpinning this research. Chapter 2 provides the background on the existing crisis readiness and response context in the UAE including current crisis readiness strategy and structures, overview of existing performance, targets and barriers, international comparison and key stakeholders. The literature review in Chapter 3 provides the theoretical basis for this research and discusses the relevant concepts and principles, key models and frameworks and the core components that comprise crisis readiness.

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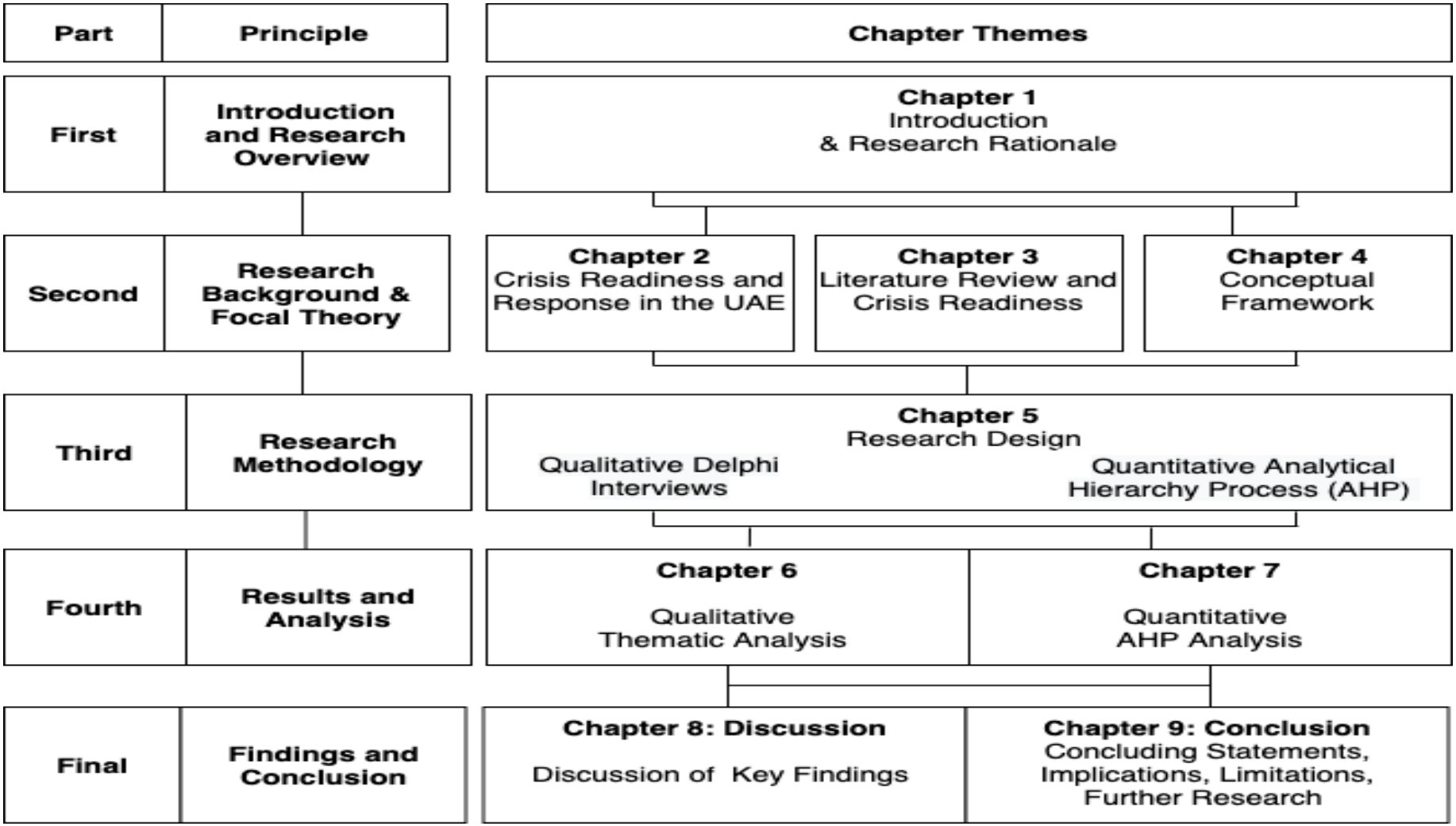

Figure 1-1 Thesis Structure

Chapter 4 presents the conceptual framework for this study drawing on key concepts and constructs identified in literature and practice to form the research model. This is followed by the research methodology outlined in Chapter 5 that situates the research within a pragmatist, mixed methods paradigm and details the rationale and the methodological procedures utilised. Chapter 6 presents the results from the qualitative phase of this research on the criteria, factors and indicators that comprise crisis readiness followed by the quantitative results presented in Chapter 7 that validate the final framework. Chapter 8 presents an analysis and discussion of the significance and implications of the research findings relative to the broader body of knowledge and practical field. This chapter triangulates all the data generated from the literature review and the primary research in relation to the research questions of this study. Chapter 9 concludes this thesis and provides a summary of the research process and key findings, discusses the research contribution and recommendations and implications for theory and practice. The final sections outline the limitations and implications for future research.

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CHAPTER 2: LITERATURE REVIEW ON CRISIS RESPONSE IN THE UAE

2.1 Introduction

This chapter aims to establish the crisis readiness context in the UAE that frames this study in respect of the key components of the system, existing practices and issues for road traffic safety. This context is critical in outlining the different institutional, legal and environmental contexts which clarify the nature and scope of crisis readiness for road crisis situations. An overview is provided of the key strategies adopted at the national level that influence the objectives, planning, structures, roles and responsibilities at all levels of crisis response in the UAE. The UAE's existing legal and national response frameworks are discussed in terms of the extent to which they define the planning and implementation of crisis management. The institutional context is addressed in respect of the key actors, stakeholders, roles and responsibilities in crisis readiness in the UAE. The broader external context and problem context of this research is defined in terms of road traffic incidents and crises in the UAE. Further the problem context for crisis readiness is clarified in terms of crisis response performance. An analysis is provided of the efficiency of crisis response focusing on the performance in terms of the specific phenomena of crisis response times in comparison with international norms and national targets. This context emphasises key challenges and a gap in planning and implementation in crisis response and specifically in the area of road traffic crisis readiness.

2.2 Legal Framework for Crisis Readiness

The UAE has been highly proactive in building its capacity to deal with national disasters and crises and has developed laws, regulations and procedures to safeguard the country and its population (UAE Interact, 2012). Federal Law Decree No. 2 of 2011 led to the creation of the National Emergency, Crises and Disasters Management Authority (NCEMA) which is entrusted with various roles (Al Nuaimi, 2012). Similar to the Federal Emergency Management Agency (FEMA) in the United States, key responsibilities include overseeing the development of national response capabilities and coordination of inter-agency initiatives at the state and local level (Al Nuaimi, 2012). This includes formulating emergency plans and ensuring that they are transposed together with

respective state bodies. NCEMA is also responsible for the management of disasters, crises and emergencies and for this purpose coordinates and cooperates with relevant state agencies (Al Nuaimi, 2012).

NCEMA is tasked as the main body responsible for the proposal and development, consolidation and update of laws, policies and procedures at the national level (NCEMA, 2016a). The body also plays a central role in the development of national standards that are applicable across public and private sectors and in different areas of crisis response. In particular standards for regulating and coordinating all crisis readiness and emergency management activities have been established. National standards currently in force include the UAE Occupational Health and Safety Management System (OHSMS) and the National Standard and the Business Continuity Management Standard and Guide UAE NCEMA 7000-2015.

While NCEMA is the central authority at the federal level, the police force in the UAE is a key coordinator and actor within the emirate crisis readiness and response. Each Emirate has a regional crisis and disaster management team headed by the high commander of the local police force (Al-Marzooqi et al., 2017). The principal objective of this team is to respond and manage any type of crisis or disaster at the local level. This includes the formation and maintenance of a risk register specific to the Emirate and responsibility for planning, training and exercises (NCEMA, 2012). In Abu Dhabi, the police force are central coordinators of crisis response and have established technologies and systems to provide and share operational and GIS locational data with partners to enable prompt activation and response in the event of a crisis (Al-Marzooqi et al., 2017). Whilst the establishment of NCEMA and the Federal Authority for Nuclear Regulation (FANR) are important stepping stones in improving UAE crisis readiness, ongoing effectiveness requires evaluation of the risk management performance and assessment of organisational effectiveness. In turn UAE decision makers need to be equipped with the requisite tools to be able to identify improvements and gaps in crisis readiness and crisis management systems.

2.3 National Response Framework

Crisis response strategies in the UAE at all levels are framed around a central crisis management standard or framework called The National Response Framework (NRF). This establishes the UAE's national response system for crises, emergencies and disasters that threaten the country's security, safety and stability (NCEMA, 2013). Its purpose is to provide the structure and context for the coordination of national response efforts towards a unified and comprehensive strategy for crisis and emergency management. The framework is considered by NCEMA to provide complete guidelines for a consistent and integrated approach and focuses on four key areas of: objectives and scope; roles and responsibilities of NCEMA and other relevant leading and supporting institutions; the National Response System and its components, in addition to training and exercises and ongoing planning revision (NCEMA, 2013). All response and support organisations are mandated to undertake the necessary measures to implement the framework. This includes planning, training, exercising, information sharing and monitoring and other measures to enable crisis readiness (NCEMA, 2013). The scope of the NRF applies to all crises and emergencies providing a blueprint for preparing and responding to any events that threaten the UAE's safety, security and stability. The framework does not outline specific provisions for each type of crisis such as road traffic crisis. Nevertheless in designating responsibilities among public agencies specific crises are identified including road traffic crises under the category of land transport accidents. The NRF identifies the Ministry of Interior as the lead agency responsible for coordinating response to land transport accidents.

The framework can be characterised as a cyclical model that specifies the key processes and direction of flow of the different stages of managing crisis events based on four pillars of Prevention and Protection, Preparedness, Response and Recovery (NCEMA, 2007). NCEMA (2007) identifies that the purpose of the initial Prevention and Protection stage is to eliminate the potential causes of crises and minimise probabilities of occurrence, accomplished by undertaking activities such as risk and threat assessments, developing priorities, and implementing preventive actions. This is followed by the Preparedness stage which establishes and implements processes and procedures related to preparing plans, resources and capabilities for response to future crises and emergencies. In this

phase a major element is the development and coordination of National Response Plans and associated training for crisis response actors (NCEMA, 2007). The Response phase is linked to the procedures and activities undertaken following crisis occurrence to mitigate its effects and provide immediate emergency relief and support to populations. The final Recovery stage alludes to short, medium and long-term processes and procedures that support the restoration of impacted infrastructure and the re-establishment of a state of normalcy.

The scope of the NRF applies to all hazard scenarios across the whole of the UAE. While the framework focuses on coordination of a national level response, its reach is intended to extend to incidents at the Emirate level consistent with local legislation and regulations. The NRF moreover provides an umbrella under which more detailed plans are formulated in respect to specific risks identified in the National Risks Register, federal and local response plans, and operational and logistical support plans for emergency management. Key strategic objectives include: the protection of life and property; enhancing the continuity of business and essential services; enhancing crisis management capabilities; providing support to local governments when needed; increasing community confidence; and reducing the impacts of crises and emergencies (NCEMA, 2013). Figure 2-1 identifies the lead and support agencies for different types of emergencies including road transport crises.

Principal roles and responsibilities are established for those participating in the framework implementation. While NCEMA is the primary crisis response agency, two further levels of responsibility exist of Lead Agencies and Support Agencies (NCEMA, 2013). Lead Agencies head the response to specific incidents according to the Risk Register and direct the use of support agency resources. Major tasks include preparation of specific response plans in cooperation with NCEMA, operational management of the crisis and local implementation and monitoring of strategic plans. The role of Support Agencies is to be prepared and support the Lead Agencies.

Risks / Responding Body	Hurricanes	Winds, Storms and Floods	Earthquakes	Land Transport Accidents	Contagious Disease and Epidemics Detrimental to Humans	Animal Epidemics	Blight
Ministry of Interior	L	L	L	L	S	S	S
Armed Forces	S	S	S	S	S	S	S
Ministry of Health	S	S	S	S	L	S	S
Ministry of Foreign Affairs	S	S	S	S	S	S	S
Ministry of Energy	S	S	S	S	S	S	S
Ministry of Environment and Water	S	S	S	S	S	L	L
Telecommunications Regulatory Authority	S	S	S	S	S	S	S
Civil Aviation Authority	S	S	S	S	S	S	S
Emirates Transport Authority	S	S	S	S	S	S	S
National Media Council	S	S	S	S	S	S	S
Supreme Petroleum Council	S	S	S	S	S	S	S

Key: L=Lead Agency; S=Support Agency

Figure 2-1 Lead and Support Agencies

NCEMA (2013, p.31).

Their main responsibilities include the utilisation of their capabilities in accordance with the direction of NCEMA, assisting lead agencies in risk response planning and preparing detailed emergency management support plans (NCEMA, 2013). Lead agencies include the Ministry of Interior and Ministry of Health although these are adapted according to the type of hazard NCEMA defines by classifying different kinds of risks and threats at different levels each of which provoke a specific level of response. Emergencies are defined as: "Any major incident or incidents resulting in serious damage to individuals or properties, or threatens the general order, the continuity of government functions, the safety and health of the population, the environment, or threatening the economy, and which requires special mobilisation and coordination between multiple agencies" (NCEMA 2007, p.18). A crisis is defined as incidents which are more complex to address than emergencies and which pose risks to the stability or wellbeing of a large proportion of society and impacts government functioning (NCEMA, 2007). While the UAE's history to data shows that a disaster has yet to occur requiring international support, there have been emergencies necessitating the combined initiatives of all crisis response agencies within the UAE or from more than one Emirate (Al-Shamsi, 2017).

The National Response System for crises embedded within the NRF categorises four different degrees of emergency and the necessary response:

- Level 1 (red) for events or a series of events with large-scale, continuous and fatal consequences requiring immediate response at national level and subject to the strategic direction of the National Crisis Emergency Management Team
- Level 2 (orange) for events with serious and continuous consequences requiring coordinated support of various Federal agencies and managed by the Lead Federal Agency (LFA).
- Level 3 (yellow) for events operationally managed by more than one response agency under the strategic direction of an LFA. NCEMA monitors and escalates the level of emergency if necessary.
- Level 4 (green) for events managed by a single Lead Local Agency supported by local support organisations.

In addition the NRF defines levels of response in terms of local, federal and national which are activated according to the degree of emergency. For example local response equates to a level 4 emergency and results in the activation of the local emergency and crisis management team. The key elements of the National Response System are depicted in Figure 2-2.

The framework specifically identifies and addresses a number of critical crisis readiness components and factors and outlines key measures and processes by which they are to be achieved. Response planning is a required activity within the framework and is centrally managed by NCEMA to address multiple specific risks. Structures incorporate a Department of Planning and Preparedness that oversees and controls response planning activities and procedures while collaborating across agencies and local and federal levels to develop risk and threat plans. These include the provision and utilisation of resources and capacities and more specifically the organisation of joint training sessions in conjunction with crisis response partners. A core responsibility is evaluating the readiness of institutions to effectively manage potential risks and threats (NCEMA, 2016b).

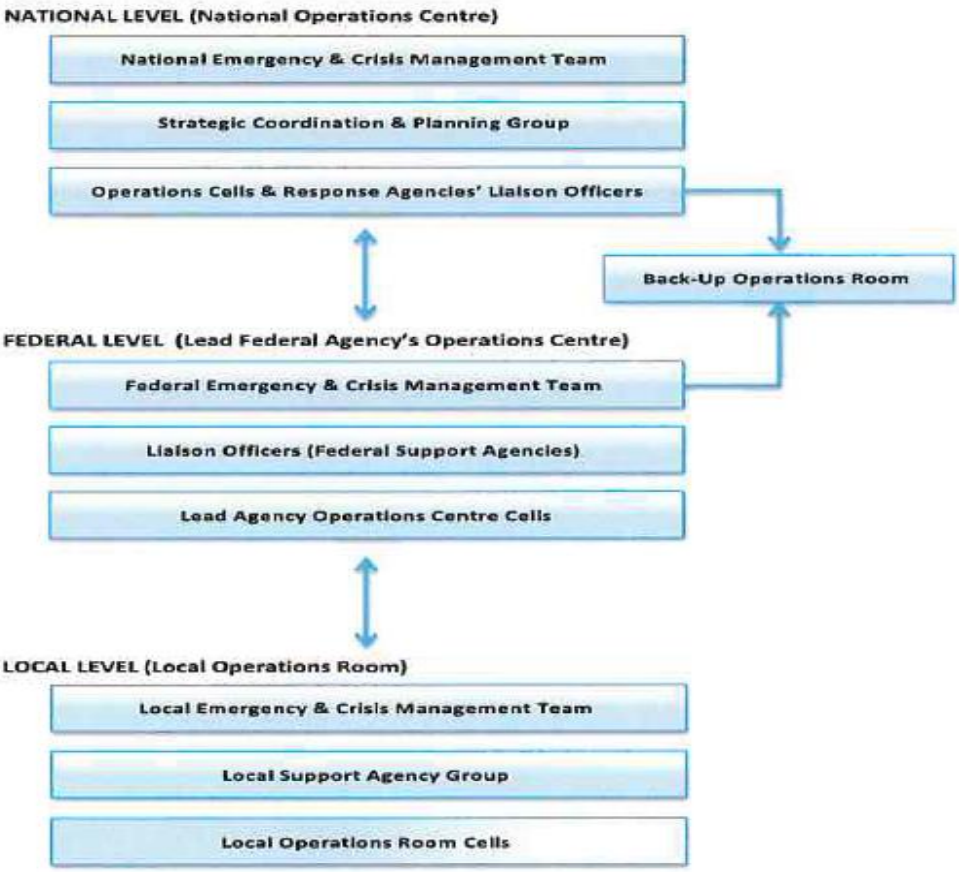

Figure 2-2 Key Elements of the National Response System

Source: NCEMA (2013, p.26).

Response planning also links to risk assessment and the development of plans for specific risks identified in the National Risk Register and requiring specific resources and strategies. Lead agencies identified for each risk are invited to cooperate in the development of plans with other stakeholders and are overseen by NCEMA in alignment with the NRF (NCEMA, 2013). Training and exercises are identified as a distinct component of the NRF that specifies a number of measures in this area. Firstly requirements for specialised training for crisis response agencies are stipulated according to their assigned roles and responsibilities in emergency response plans. The implementation of joint exercises is also mandated with the stated aim to develop capacities for coordination among the different organisations during crises and emergencies (NCEMA, 2013). A third element of training needs analysis is identified as a critical aspect of training strategies for all crisis response actors at national and local

levels. This responsibility is centrally managed by NCEMA's Planning and Preparedness Department (NCEMA, 2016c).

Risk and hazard management is mandated within the NRF which specifies roles, responsibilities and processes and incorporates several elements that promote risk identification in crisis readiness and response. Firstly NCEMA coordinates at national and local levels with different agencies to identify, record and periodically review and update risks and threats in a National Risk Register (NCEMA, 2013; NCEMA, 2016a). Secondly the NRF facilitates risk anticipation by mandating the establishment of an information and resource centre for emergencies and crises to anticipate risks and ensure preparedness based on studies and scientific research. Undertaking research and field surveys is a key practice implemented to provide evidence that underpins prevention measures (NCEMA, 2013). Moreover NCEMA in its documentation links risk identification and prevention with the Department of Safety and Protection, established with the task to develop and apply standards and requirements that help to safeguard public safety and ensure business continuity such as building safety and security standards, as well as formulate prevention policies and procedures (NCEMA, 2016b).

The NRF further specifies an information management and communication (IMC) strategy for crisis readiness and response. Specific measures have been developed for addressing operational communications between crisis response actors based on three key elements: a resilient communications infrastructure, interoperability between communications systems and established communications protocols and procedures. Operational communications are overseen by NCEMA through the National Operations Centre (NOC) Communication Cell which monitors the crisis situation and ensures effective communications with and between stakeholder response agencies during the crisis (NCEMA, 2013).

In terms of the technological dimension of IMC a separate Information and Communication Technology Department within NCEMA has been created. The primary role is to ensure the establishment and management of advanced systems and infrastructure including networks and databases that provide NCEMA and partners with systems, software, communication services and devices (NCEMA, 2016d). A key attribute of the UAE's information strategy is the collection of data and the development

of national databases that store information on risks as well as available crisis resources at all levels from local to federal (NCEMA, 2016e).

The framework further specifies measures, mechanisms, and processes for public communications. A standalone Department of Media and Communication within NCEMA specifically addresses national media channels and links the Authority to national media institutions and through them, the public. A key part of the department's remit is to increase community awareness of appropriate actions to be taken before, during and after crises and emergencies as well as provide immediate guidance and warning in the case of crisis (NCEMA, 2016f). This incorporates a dedicated unit that collaborates with partners specifically to manage crisis from the perspective of the media. Communication with the public is characterised by the use of multiple communication mechanisms including social media as specified in the national framework and developed to provide authorised information and inform, update, guide and reassure on emergency and crisis events (NCEMA, 2013).

Resources are identified as a key component of the National Response Framework in which specific provision is made for the coordination of the use of national resources through NCEMA (NCEMA, 2013). An integrated planning approach has been adopted that aligns the development of operational and logistical plans with risk response plans. A level of resource contingency planning is evident in provisions in the NRF which mandate the strategic stockpiling of essential goods and materials to secure supplies in the event of major crises and disasters. Stockpiles are maintained by stakeholder agencies in coordination with NCEMA (NCEMA, 2013).

The incorporation of advanced technological systems is a major characteristic of the UAE's resources for crisis management. A key example is the use of geospatial systems and capabilities by NCEMA, UAE police forces and civil defence organisations to generate intelligence that can be used to create preventive crisis safeguards that help to protect security and safety. In particular NCEMA recently implemented National Spatial Data Infrastructure (NSDI) which provides information technology architecture for integrating spatial data into operations based on nationwide map data and geographic information systems (GIS) data (GeoDecisions, 2015). In 2019 Dubai Civil Defence organisations gained access to a comprehensive 3D GIS mapping system of Dubai as part

of the Emirate's strategy to develop and implement geospatial infrastructure. The aim is to provide background information to crisis responders that will allow for the formulation of appropriate tactics and the dispatch of the necessary equipment and resources (Gokulan, 2019).

The framework further attempts to address recovery initiation and property protection. Recovery initiation is embedded within the terms of reference of NCEMA that specifies that the Authority should ensure the development of appropriate plans, processes and procedures that respond to national legislation and requirements for reconstruction and recovery at national level and local level (NCEMA, 2016e; Dhanhani et al., 2010). Additionally the NRF framework makes provision for the establishment and activation of a Recovery Planning Group that acts in consultation with the national emergency and crisis management team. A commitment to recovery initiation is indicated in specified budgets for post-disaster reconstruction and damage indemnification (Al Marzooqi, 2017). In terms of property protection the main thrust is a preventive approach spearheaded by standards and safety codes designed to safeguard human and property safety (Al Marzooqi, 2017).

A national early warning system is not included in the NRF as this was only recently initiated in 2017 under the control of NCEMA and is still in its infancy. NCEMA (2017) defines the system as a set of procedures, policies and technologies that comprehensively focus on the safety of all residents in the UAE, including visitors. A number of key objectives have been identified in terms of: preserving life and property through reaching as many people as possible to warn them in a timely manner of potential danger or threat; the integration of advanced electronic systems to ensure the accuracy and speed of warning messages; governance and coordination of the EWS at all levels of the country and among all crisis readiness agencies and organisations (NCEMA, 2017). The communication component is based on multiple dissemination channels to broadcast warning messages including mobile phones, smart road signage/billboards, radios, televisions and loudspeakers in mosques. Mobile devices and apps are the dominant mode for dissemination of alert messages to populations at risk. The content of messages provides warning in addition to instructions for the public (NCEMA, 2017).

As a recently developed economy the UAE has adopted best practices and guidance on crisis management and readiness from more advanced nations such as the UK. NCEMA is additionally signatory to several international emergency management agreements with different countries such as the US, UK and Italy to enable the country to gain from international expertise and support the integration of human, technical and scientific measures to address crises (Al-Shamsi, 2017). The integration of best practice is supported by processes to identify best practices globally in terms of systems, procedures and training and to facilitate their sharing (Dhanhani et al., 2010). Evaluation of crisis response performance is also identified as a key element within the framework which specifies a process that enables a complete record of actions and decisions undertaken during crisis events that can be used for post-crisis review and evaluation processes and the identification of lessons (NCEMA, 2013).

The comprehensive application of the National Response Framework to all stages of the emergency crisis management cycle however diverges from practice in developed countries (Alteneiji, 2015). Literature shows that frequently separate frameworks for each element of the cycle of mitigation, preparedness, response and recovery are formulated. Moreover the crisis management standards in countries such as the US incorporate all the frameworks within the preparedness phase (FEMA, 2015).

2.4 Crisis Readiness Actors

The crisis readiness structure in the UAE consists of multiple actors at national, federal and local level with different functions and roles in crisis readiness and response. In contrast to nations such as the US, Australia and the UK the country has adopted a centralised, top-down approach in which crisis response is coordinated by a central overarching agency with levels of autonomy at local level for crisis readiness (Alteneiji, 2015). Established in 2007 NCEMA is the key specialised authority with overarching responsibility for crisis management regulation and coordination in the UAE. Coordination at all levels of government local and national is aimed at ensuring collaboration and the establishment of effective measures able to address all risks and threats (NCEMA, 2007). Its core mission is to “enhance the capabilities of the UAE in managing emergencies, crises and disasters, and to coordinate all national efforts to save lives, preserve property and assets by minimising the effects of emergencies and crises,

and coordinating the national recovery efforts" (NCEMA 2017, p.27). Its main responsibilities besides national coordination of emergency response extend to supervising the preparation, integration and implementation of strategic crisis plans in cooperation with organisations that have key responsibilities. It provides emergency management guidance and oversight to federal ministries, local authorities, and agencies to enhance response capabilities and leads the preparation of the National Risk Assessment at federal and local levels. NCEMA established and manages the National Operations Centre which provides the 24/7 monitoring of all incidents. A core responsibility is the development of criteria for evaluation of crisis readiness and response in cooperation with federal authorities as well as ensuring the implementation of lessons learned following actual crises and training exercises (NCEMA, 2017).

NCEMA consists of six main departments: Operations Department, Planning and Preparedness Department, Support Services Department, Information and Communication Technology Department, Media and Public Information Department and Safety and Prevention Department. Coordination of crisis response across local and national levels is also addressed within crisis management structures in the establishment of NCEMA's Local Centres Department, comprised of local centres in each of the seven Emirates. The Department focuses on local events and undertakes the necessary measures to develop, update and implement local response and recovery plans as well as improve local crisis readiness and emergency preparedness (NCEMA, 2016e).

The Ministry of Interior (MoI) is a key actor in crisis readiness and response and the Lead Agency in Land Transport Accidents. This is because of their remit to supervise police and security forces as well as the federal Civil Defence General Command. Part of the core mission of the MoI is to provide protection and security of establishments and property and importantly regulate road traffic (NCEMA, 2013). The MoI has established and heads the team that coordinates search and rescue missions and oversees the National Enquiry System activated for an emergency event classified as a Level 1 or 2 emergency (NCEMA, 2013). While the ministry integrates the police and security systems in the UAE, local police authorities are responsible for maintaining law and order in each emirate (UAE, 2019).

The Civil Defence General Command is a federal-level entity with the mission to safeguard lives, properties and the environment in the event of a crisis and plays a vital role in industrial and commercial safety. Key responsibilities include the preparation and implementation of plans to combat crises and emergencies and coordination with partners in addition to public education and awareness, prevention and training on emergency procedures (CDGC, 2017).

Each emirate has its own civil defence department that is a key actor at the local level and mainly responsible for conducting operations in crisis response and recovery in coordination with local structures. In addition the departments are mandated to continuously develop and update equipment, systems and tools for firefighting and rescue in alignment with the urban development and the environmental context of each emirate of the UAE. Civil Defence consists of a range of different departments with different specialisms and functions including Preventive Safety Department; Training and Performance Development Department; Fire and Rescue Department; Fire and Marine Rescue; Air, Fire and Rescue Department; Central Operations Department; Internal Monitoring Department; Corporate Strategy and Performance Department (CSP). The key focus of their work on civil and industrial safety and sustainable development is guided by principles of Total Quality Management and certification and standards such as ISO 9001, Occupational Health and Safety Management System certification OHSAS 18001 and the Environment Management System ISO 14001 certification (DCD, 2018).

The UAE police play critical roles in crisis response and particularly in relation to road traffic crisis incidents given their responsibilities in regulating traffic on a strategic and operational basis (UAE, 2019). Police forces in each individual emirate head the civil defence structures in place. In Abu Dhabi the Civil Defence Directorate is supervised by the Abu Dhabi Police while similarly in Dubai the Emergency Management Committee containing Civil Defence authorities and other relevant stakeholders is headed by the Dubai Police. Similarly police agencies within each emirate of Sharjah, Fujairah, Ajman, Ras Al Khaimah and Umm Al Quwain oversee their local Civil Defence Departments. The role of police officers in crisis readiness and response is increasingly varied and complex emphasising the need for a common approach or standard to preparing for crises. The police are central actors in crisis readiness and response before, during and after

disasters. One key responsibility is informing the public prior to and during the course of crisis and disaster incidents (Hilton, 2017). Acting as a bridge between communities and national incident management systems, the police are frequently the critical first communicators to the public and are responsible for providing timely and clear information on the nature of the crisis, what the public can do to mitigate the risk and stay safe, and where they can find help (UN, 2008).

The fast pace of change currently witnessed within societies and the built environment has changed expectations of law enforcement and policing within modern cities. Contemporary law enforcement agencies are expected to engage in a wide variety of activities including immediate and rapid response to incidents, crime prevention, promotion of traffic safety and response to road related incidents, monitoring and responding to social disorders, safety of critical physical infrastructure, supporting strong partnerships with communities, and a response to national disasters as and when they strike. Following the occurrence of a crisis the police are focal actors in investigating and coordinating search and rescue operations and recovery efforts of both people and property. This frequently entails the need to coordinate with multiple agencies and jurisdictions to ensure effective response. Law enforcement officers are key links to the community and their knowledge of local conditions and needs provides valuable situational awareness to attending response and recovery teams. In particular police communicate and share information on unique challenges and any barriers in providing assistance such as language (Hilton, 2017). At the same time ensuring public safety and protection remains a primary duty in disasters similar to police roles in daily life in supporting the community.

Other key relevant actors include the federal and Emirati level transport and road traffic authorities. This includes the Federal Transport Authority – Land and Maritime, Abu Dhabi Department of Transport and the Dubai Road Traffic Authority. In each of the other emirates road authorities work in cooperation with civil defence departments such as the: Road and Transport Authority in Sharjah; the Transport Authority in Ajman and Ras Al Khaimah; the Traffic Department in Umm Al Quwain; and the Traffic and License Department in Fujairah. These authorities are mainly responsible for road safety management, road safety awareness and road safety audits. Ministries including the

Ministry of Health and Ministry of Environment and Water are Supporting Agencies when required in road traffic incidents. The UAE's Army and Special Forces may also be activated to help support response efforts in the event of a major crisis. SANID is the National Emergency Response Volunteer Program of the UAE, launched in 2009 with the purpose of recruiting and training cadres of emergency response volunteers nationwide to equip them to respond to national and local emergencies and crises. The programme aims to draw on the strengths of proven international models such as the Swedish Civil Defense League and the US Citizen Corps to contribute to community resilience towards disasters, crises and emergencies. Since its inception SANID has trained a total of 14,289 volunteers, of which nearly half have completed the Basic Disaster/Emergency Response Course (SANID, 2018).

2.5 Road Crisis Events

As traffic on the UAE's roads has steadily increased there has been a concomitant rise in road traffic accidents. Road fatalities are the second largest cause of death in the UAE after heart disease (DoT, 2018). Fatality rates are three times those in the UK at 7.95 deaths per 100,000 inhabitants in 2016, a rise of 7.4% over 2015 (RoadSafetyUAE, 2018). Data from the World Health Organisation (2015) put this figure much higher at 18.1 traffic-related fatalities per 100,000 inhabitants as shown in

Table 2-1. The table reveals that the UAE lags behind Western economies such as the UK, Germany and France which range between 3.1 to 5.5 road fatalities. When compared regionally, the UAE demonstrates a better comparative safety performance, with only Qatar registering a lower fatality rate while that in Saudi Arabia is nearly double that of the UAE.

Table 2-1 Country Comparison of Traffic-related Fatality Rates

Country	Road Fatalities per 100,000 inhabitants	Data Year
United Arab Emirates	18.1	2013*
World	18.2	2016**
United Kingdom	3.1	2016**
United States	12.4	2018**
Germany	4.1	2016**
France	5.5	2016**
Australia	5.6	2016**

Saudi Arabia	27.4	2013*
Qatar	15.2	2013*
Oman	25.4	2013*

*=Source: WHO report (2015); **= Source: WHO report (2018)

In 2016 the UAE received a total of 2,800 calls in relation to heavy traffic accidents involving injuries and deaths. The Emirate of Dubai accounted for nearly half of these incidents with a total of 1,073 (MoI, 2017). In 2016 official data shows that traffic accidents in 2016 caused a total of 725 deaths and 6,681 causalities. Over 25% of road fatalities are pedestrians while road accidents are one of the leading causes of mortality amongst children (UAEGov, 2020). Speeding is acknowledged as a major contributor to UAE road traffic accidents and deaths in addition to bad driver habits such as tailgating and dangerous overtaking. In 98% of road traffic accidents passengers were not wearing seatbelts (Al Ramahi, 2017; RoadSafetyUAE, 2018). Young drivers between 18-30 are responsible for nearly half of the accidents occurring on the UAE's roads (Gulf News, 2019). Recent surveys of UAE motorists' perceptions and experiences show that one in five drivers were involved in a road accident over the previous six months and a significant minority of 43% believed that the UAE's roads were becoming more dangerous due to bad driver habits (Webster, 2019).

The UAE's roads are vulnerable to a range of threats and hazards and recent history shows the country has experienced a number of major road traffic incidents over the past two decades. Aside from the disruption caused by natural disasters, the UAE has experienced a number of significant road crash events leading to substantial injuries and even loss of life as well as extensive damage to vehicles. For example the year 2008 was witness to a pile-up on the Abu Dhabi-Dubai highway involving almost 200 cars in fog-bound conditions which claimed the lives of at least four people and caused more than 40 serious injuries (Arafah, 2008). On the same highway in 2011 one death and 61 injuries occurred in a 127-car pile-up, similarly caused by a combination of heavy fog and speeding (GulfNews, 2011).

Recent incidents also suggest that flooding on the UAE's roads from unusually excessive rainfall can occur provoking significant risks of accidents. The most recent incident took place in January 2020 which experienced a record amount of rainfall leading to widespread flooding and damage across the Emirates to roads and infrastructure

(Kumar, 2020). In this case the Ministry of Infrastructure and Development were key partners in crisis response in terms of assuming three key tasks of draining waterlogged roads, removing mud and heavy debris, as well as repairing roads that may have been damaged by the rain. Notably however resources in terms of sufficient pumps and drainage equipment across major cities in the Emirates were highlighted as a key issue (Kumar, 2020). The UAE's motorists are also vulnerable to accidents provoked as a result of regular sand and dust storms that reduce visibility on roads. For example in July 2018, more than 1,000 road accidents including 12 major crashes were recorded in Dubai in only a few days as a result of a heavy dust storm (Al Ramahi, 2018).

The frequency of accidents has been declared a national disaster by the UAE government (Bener and Crundall, 2005) and to address this issue the long-term policy goal has been defined to reduce the number of road deaths to three per 100,000 inhabitants by 2021 and zero by 2030 (Al Ramahi, 2017). Several key road safety initiatives have been introduced to support achievement of these objectives including the Strategic Traffic Safety Plan focusing on four key areas of enforcement, education, engineering and emergency medical services, in addition to road safety awareness programmes across each emirate. Strategic actions to address the enforcement issue have included the 2017 introduction of a new law to strengthen road safety and reduce road traffic injuries and fatalities to a targeted 3 per 100,000 inhabitants by 2021. Several measures were specified to achieve these aims, of which potentially the most important is the introduction of mandatory seat belts for all vehicle occupants. Moreover the application of specific sanctions were stipulated for a range of reckless driving behaviours, speeding and driving while under the influence of drugs or alcohol (UAEGov, 2020).

Strategic objectives to educate and raise public awareness are supported by the establishment of multiple road safety initiatives and awareness campaigns by different government entities (UAEGov, 2020). A road safety audit is a mandatory preventive measure introduced by Abu Dhabi's Department of Transport for all new highway projects and applied to the phases of design, construction and post-construction. The purpose is to identify road safety problems and to suggest measures to eliminate or mitigate any concerns (UAEGov, 2020). A further preventive measure is the introduction of an adaptive central traffic control system known as 'SCOOT' in both Abu Dhabi and

Dubai. The system is installed with sensors that quantify the volume of vehicles at signals to enhance traffic flow at key junctions (UAEGov, 2020).

A speed management strategy formulated in Abu Dhabi is a key road safety initiative that comprises six major components of: assessing the speeding problem; engineering; laws/legislation; education and awareness; enforcement; and stakeholder coordination (UAEGov, 2020). Dubai's traffic safety strategy aims to reduce road deaths to 1.5 for every 100,000 of the population by 2021 (UAEGov, 2020). This target, accepted and acknowledged as challenging by the UAE government, aligns with the UAE's long-term policy goal of zero deaths by 2030 by going further than federal level targets for 2021 and reducing mortality rates to a significantly low level (UAEGov, 2020). It aims to achieve an effective traffic safety strategy based on four key pillars of: improving motorists' driving habits; inspecting vehicles for traffic safety regulations and for criminal safety procedures; inspecting motorists' records; and traffic awareness campaigns (UAEGov, 2020). To raise public awareness of traffic safety the UAE's Roads and Transport Authority (RTA) launched a major safety campaign that is continuous and ongoing since 2008 and exists under the slogan Haseb, which means "take care" in Arabic. The campaign highlights safety issues on roads and in transportation and other safety behaviours (UAEGov, 2020). A "white points" system, in contrast to the "black points" earned for driving violations, also incentivises drivers in Dubai with rewards if they do not commit any traffic breaches in the UAE in any given year (UAEGov, 2020).

An innovative new measure with the potential to significantly reduce crisis response times across the Emirates is the recent launch of FAAZA, an automated eCall system that can report a traffic accident to the nearest police station and emergency centre within ten seconds (Arabian Business, 2019). The system is believed likely to accelerate accident response times by providing sophisticated features for rapid communication with emergency teams, enabling automatic and voice information to be received and logged into the system simultaneously rather than relying on conventional practices of print commands (UAEGov, 2020). Emergency service personnel in operation centres will further be able to make contact and speak to passengers and check their condition (Arabian Business, 2019). While the technology will be compulsory in all vehicles driven into the UAE from 2021, it is as yet unclear whether existing vehicles will be required to

be fitted with this same technology (Arabian Business, 2019). Innovations in Dubai extend to a new Traffic Incidents Management (TIM) system launched to respond to accidents and events on the main Dubai to Abu Dhabi highway. The system is expected to help clear minor accident sites within 10 minutes to reduce traffic congestion by 25%. TIM units are equipped with advanced technologies including interactive screens and communication devices to address vehicle breakdown, rapid intervention at emergency sites and surrounding roads, and the handling of minor accidents that do not warrant the presence of the police (GulfNews, 2018).

2.6 Crisis Response Performance

A key area of interest for this study is the response time to emergencies in the UAE. Governments and agencies globally have formulated or adopted systems for classifying and prioritising emergency incidents. These generally use three or five incident categories ranging from life-threatening to not requiring a response to assess the type and speed of response required. For the life-threatening category, a targeted response time of 15 minutes from the moment the dispatcher accepts the call to arrival at the scene is a widely accepted benchmark.

Existing average police response times to crises and emergencies in different areas of the world provide further indicators and benchmarks for global best practice. Table 2-2 ranks response times among major global cities and shows that in 2017 the average response time in New York was 7:06 minutes, 12 minutes in Singapore and 14:44 minutes in London. In comparison internal data from the Ministry of Interior shows that the response time in the UAE was 11.97 minutes, an improvement over the 2016 response time of 13.16 and earning the UAE a higher place in ranked comparisons (MoI, 2017).

The UAE has placed considerable emphasis on ensuring public safety both to avoid crises and in crisis response. To advance this goal key national indicators have been formulated that provide measures of performance in critical areas and have core relevance for road crisis response. Major targets for 2021 include:

- 3 road accident deaths per 100,000 inhabitants (6.31 in 2016)
- Emergency Response time of 4 minutes by 2021 (11.97 seconds in 2017) (MoI, 2017)

Table 2-2 UAE Response Times Rankings

Global Comparison	2016		2017	
1	New York	6.57	New York	7.06
2	London	9	UAE	11.97
3	Singapore	12	Singapore	12
4	UAE	13.16	London	14.44

Source: Ministry of Interior (2017)

Despite gradual reductions in average response times over the last three years there is a wide gap in the UAE between current practice and the national target of 4 minutes. To support achievement of this goal the UAE has decomposed the emergency response communication process into five key stages of Reporting, Receiving the Communication, Sending, Disseminating and Arrival/Closure. Reporting is the first step when the 999 emergency communication is first received by the control room followed by the next stage of Receive the Communication when the site or location of the caller is identified. In the Sending phase the emergency message is communicated to civil defence operations centres. This is succeeded by Dissemination in which the GPS location of the crisis is distributed to responders and they travel to the scene.

The final stage is Arrival at the crisis incident and Closure of the case. Table 2-3 shows the 2015 average performance times and targets for each of these elements and the aggregated overall response time. While the first stage of Reporting is outperforming the target response time there is a performance gap in the remaining four stages. Optimisation requirements indicate that an overall reduction of 12.44 minutes from the 2015 average crisis communication response time is required to achieve the 2021 target (MoI, 2017).

Table 2-3 Optimisation Requirements for Stages of Communications Response Times

Stages of Communication Response	Reporting	Receive the Communication	Sending	Disseminating	Arrival and Close Case

Performance in 2015	00:05	02:04	02:22	12:13	16:44
2021 Target	00:10	01:00	00:10	02:40	04:00
Optimisation Requirements		-01:04	-02:12	-09:33	-12:44

Source: Ministry of Interior (2017)

The Ministry of Interior has identified a number of challenges in relation to attaining the target time for each of these processes. A lack of standardisation across all control room processes and procedures is emphasised as a major constraint (MoI, 2017). In terms of Reporting the caller's location can be difficult to establish accurately and many sites in the UAE have imprecise addresses. Frequently the URL has to be used to establish location. Receiving the Communication can be subject to language barriers which can slow down response times. The Sending stage is significantly underperforming requiring substantial optimisation in processes to attain the target. Identified challenges include response team and police patrol locations which can be inaccurate and unavailable to all response stakeholders, as well as insufficient TETRA coverage and inability to support data transfer (MoI, 2017).

The Disseminating stage reveals the largest performance gap requiring a reduction of 9 minutes over current response times. Multiple issues are defined that currently constrain faster distribution of GPS locations to respondents and their rapid arrival at the emergency scene: inability to provide GPS location to respondents; a lack of active tracking policy and procedures in relation to red traffic light stops; traffic congestion; insufficient number of distributed resources; and differences in key performance indicators for response times across each Emirate. In the final Arrival and Closure stage limitations are identified in the use of paper-based reporting, and lack of communication with control rooms in terms of closure and availability of respondents (MoI, 2017).

2.7 Conclusion

This chapter described the situation of the UAE crisis response context and outlined the key elements of the existing system and developments. It is evident that the UAE has prioritised crisis readiness and implemented planning, development and operational systems in respect of the legal and national framework for crisis readiness, and the organisational structures and decision-making. The data shows an increase in road crisis

events combined with sub-optimal road traffic response times. In terms of maturity crisis readiness in the UAE is still in its infancy. This research context emphasises the problem context as a driver for the exploration and development of a comprehensive framework for crisis readiness that contributes new theory that supports the development and evaluation of crisis readiness in this context.

CHAPTER 3: LITERATURE REVIEW ON CRISIS READINESS

3.1 Introduction

This chapter presents a review of the relevant literature in the field of emergency and disaster management with a specific focus on the concepts of crisis readiness and preparedness. The focus of this study is the development of a comprehensive framework for crisis readiness for road traffic that can be used to guide practitioners. The conceptualisation of this concept draws on the relevant literature and praxis to establish theoretical support for the key dimensions and components of the operational framework. The primary goal of this review is to evaluate the literature, theories and concepts and evaluate the degree to which the notion and principles of crisis readiness has been conceptualised and identify critical knowledge gaps.

The review firstly addresses the definitions of crisis and clarifies the different related terminologies. By exploring and clarifying the concept of crisis and identifying its essential facets a broad criteria can be developed which informs the concept of crisis readiness. A comprehensive model or framework for crisis readiness for road traffic situations is lacking in the literature and therefore the literature is reviewed to explore and conceptualise the concept and identify key principle and elements. This draws firstly on principles and models of crisis management that identify the key processes and strategies underpinning readiness and response. After establishing the broader dimensions of the concept of crisis a review of the focal concept of crisis readiness is undertaken to identify and define key principles and components that are informed by studies and general national models and frameworks of crisis readiness. While the term crisis readiness appears as a focal construct in a small number of studies addressing road crisis situations, a review of the broader crisis literature reveals key elements of readiness and preparedness. A review of crisis readiness and preparedness frameworks and models reveals a comprehensive range that underline specific attributes of different elements. Research on road crises and traffic crisis management identify the factors that positively or negatively impact on effective traffic incident management. This review provides the key dimensions that inform a conceptual framework for crisis readiness in road traffic situations.

3.2 Literature Overview

A systematic literature search process was conducted to identity relevant studies in this field and establish the pattern of research and contributions to crisis readiness for road traffic situations. Relevant search terms were used to ensure a broad search that would capture all relevant studies. Scopus was chosen for its extensive multidisciplinary coverage which is suitable for the cross-disciplinary nature of this topic. Initial key terms included: 'crisis readiness', 'crisis response', 'crisis management', 'crisis preparedness', 'disaster readiness', 'disaster response', 'disaster management', 'disaster preparedness' 'emergency response', and 'emergency preparedness'. Search using these criteria resulted in the retrieval of over 52,613 articles between the years 1986 and 2020. These terms were cross-referenced with the terms 'road' and 'traffic' to narrow the focus on studies in this context which further reduced the result to a total of 1,114 studies. These studies were screened by reviewing the title and abstract resulting in a total of 125 relevant studies which address road crisis themes. The review showed that the literature is highly dispersed and fragmented across a broad range of disciplines and journals. A large majority of the literature as shown in Table 3-1 is distributed across a range of fields concentrated in computing and engineering (50), logistics and transport (21) and emergency science (18).

Table 3-1 Article Distribution Across Academic Journals

Journal	NO
Computing and Engineering	50
Logistics and Transportation	21
Emergency Science and Management	18
Crisis Analysis and Prevention	9
Information Management	6
Simulation and Modelling	5
Emergency Operations	3
Critical Infrastructure	2
Miscellaneous	11

Figure 3-1 shows the timeline of research between 1986 and 2020 with the majority of research on road traffic research gaining interest from 2017.

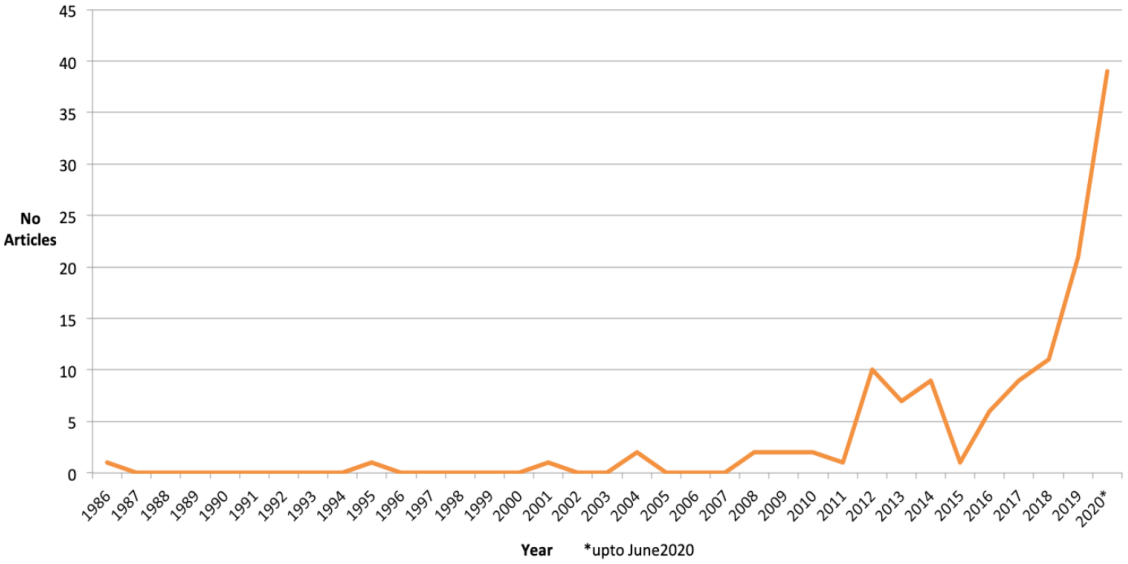

Figure 3-1 Road Traffic Crisis Articles Over Time

Drawing on the terminologies within the title and abstracts thematic analysis of the 125 studies showed that over half (70) were classified as emergency response and in a small number of cases emergency management (9) or emergency preparedness (3). Approximately a fifth of studies (30) were classified as disaster management, disaster preparation or disaster response. As indicated in

Table 3-2 only a small number of studies (14) were classified in terms of crisis.

For the literature on emergency management the pattern of research shows that a high proportion is focused on road accidents rather than road crisis which is a much more unstable, large-scale event with serious negative impacts. The studies cover a wide range of distinct and discrete themes such as: optimisation and statistical models (e.g. Maleki and Foroutan, 2011; Hamim et al., 2020); information systems (e.g. Alade and Adepoju, 2010; Azami-Aghdash et al., 2017); and location retrieval (e.g. Gupta et al., 2019; Arispe, 2020). Of these emergency related studies only six in total specifically deal with road traffic crises, and focus on diverse areas such as early alarm tools (Mohammed and Najem Alaloosy, 2018); response systems (Bhargav and Singhal, 2013; Goh et al., 2014; Sishwa et al., 2019); responses to specific road crisis events (Mikalsen et al., 2020); and management of road crisis response to a particular crisis weather event (Zhu et al., 2020).

More information on the major themes found in the literature can be found in Appendix 1.

Table 3-2 Research Contexts

Research Topic	Thematic Area	No Studies
Crisis Management	Road Traffic Accidents/Crisis	5
Crisis Readiness	Road Accidents	5
Crisis Response	Road Accidents/Crisis	4
Disaster Management	Road Accident	15
Disaster Preparedness	Road Accident	4
Disaster Response	Road Accidents/Crisis	11
Emergency Management	Road accidents	9
Emergency Response	Road accident/accident management	70

The pattern of research in the disaster management literature points to a focus mainly on disaster management (15) and disaster response (11) and a comparatively reduced focus on disaster preparedness (4). Studies in this latter area exhibited a narrow range of topics focused on road accidents and the impact of natural hazards or environmental factors (Yaacob et al., 2019; Li et al., 2020), or the role of analysis and monitoring and forecasting (Begum et al., 2019; Feng et al., 2020). Themes in relation to disaster management and disaster response were varied and distinct and included research into the role of social media in road network analysis (Emadi et al., 2017; Chen et al., 2020) and the application of AI (Sun et al., 2020). Of all of this literature only 3 studies are in the context of road crisis, and are related with the concept of disaster response rather than disaster readiness. Two of the studies focus on technological systems (Rashid et al., 2020; ul Hassan et al., 2020) while Gajanayake et al., (2018) study community adaptation to cope with disaster related failure in road networks.

Of the small number of crisis-classified studies only 9 were in the domains of crisis readiness or crisis response. The majority of studies focused on the context of road accidents and only three studies overall focused on road crises however investigation was related to highly distinct elements. In terms of the pattern of research into crisis readiness no study specifically examined road traffic crisis, with the focus in the majority of cases on road accidents and modelling and optimisation (Gao and Chen, 2010; Matta et al., 2012; Viskup and Víchová, 2019). Viskup and Víchová, (2019) study routing evaluation

and optimisation in the specific context of responding to road crisis medical emergencies while Matta et al., (2012) apply modelling and situation representation techniques to enhance decision-making during the management of road crises.

Meanwhile two studies on road crisis in the context of crisis response had distinct themes: location and routing optimisation in the specific crisis condition of flooding (Coles et al., 2017); and decision-making platforms for road crisis response (Barthe-Delanoë et al., 2014). The final study linked to the domain of crisis management and specifically information decision support systems (Henchey et al., 2014). These results point to a gap in the literature and knowledge in terms of a holistic and integrated model of road traffic crisis readiness that comprehensively addresses key dimensions and factors.

Table 3-3 Ranked and Non-Ranked Journals

Ranking	No Journals	%
5+	*4*	*3.2%*
4+	*3*	*2.4%*
3+	*8*	*6.5%*
2+	*3*	*2.4%*
1+	*4*	*3.2%*
0	*106*	*84.8%*
Total	*125*	*100%*

In terms of the quality of research as shown in Table 3-3 based on ranking only 15% of the studies in the field appeared in journals ranked 1* and above based on average ranking by ABJ and SJR journal ranking. Notably the proportion of articles published in ranked journals has risen concurrently, and of the studies published in 2020 only three are not published in SJR ranked journals.

3.3 Crisis and Disaster

A review of the literature offers insights into the similarities and distinctions and associated definitions that are critical for informing the scope of crisis readiness. The terms crisis and disaster are often used interchangeably to refer to distressing situations in which a series of events have or can have very negative consequences for human

beings, societal functions or fundamental human values. Nevertheless, the terms are sufficiently distinctive to merit some clarification. Disasters have critically affected human beings from the beginning of our existence. Disasters have the potential to threaten sustainable development through the destruction of long-term investment and efforts and the rerouting of resources intended for core areas such as health, infrastructure and education (Steenbruggen et al., 2012a). Disaster has been defined differently in the literature depending on its context. According to one definition it is "an occurrence of natural or manmade disasters that has resulted in severe property damage, deaths, and/or multiple injuries" (FEMA, 1990, p.1). In the main disaster is defined as an unpredictable or unforeseen event or sequences of events, which unexpectedly disrupts the natural flow of daily life and causes prevalent damage to human lives, economy and environment (Jorgustin, 2012). In addition, the term disaster is associated with large-scale one-off high impact events or as an event that overwhelms the local capacity to respond and contain it (Coppola, 2015). In contrast, a crisis is viewed as step down from disaster where the literature emphasises a number of different facets of instability, uncertainty, unpredictability or serious and/or imminent threat. It can be defined as an urgent situation of uncertainty and ambiguity, insecurity, and difficulty, that can have negative impacts or threaten wellbeing, reputation or survival and require a rapid response (Pearson and Clair, 1998; James and Wooten, 2005; OED, 2018).

Several definitions underline the uncertainty, consequences and decision-making as key facets. Fink (1986, p.15), one of the earliest scholars of crisis management, define it as "A crisis is an unstable time or state of affairs in which a decisive change is impending – either one with the distinct possibility of a highly undesirable outcome or one with the distinct possibility of a highly desirable and extremely positive outcome". Rosenthal et al., (1989, p.10) identify crisis as: "…a serious threat to the basic structure or the fundamental values and norms of a social system, which—under time pressure and highly uncertain circumstances—necessitates making critical decisions." The speed of response is seen as decisive factor: "a low-probability, high-impact event that threatens the viability of the organization and is characterized by ambiguity of cause, effect, and means of resolution, as well as by a belief that decisions must be made swiftly" (Pearson and Clair, 1998, p.60).

This urgency is reflected in definitions that emphasise the time and space as "a situation that threatens high-priority goals of the decision-making unit, restricts the amount of time available for response before the decision is transformed and surprises the members of the decision-making unit by its occurrence" (Hermann 1972, p.13). Rosenthal et al., (1989) similarly identify the possibility for crises to emerge suddenly or to be slower in onset and more protracted. According to the literature these two types of crises are perceived differently within organisations. Abruptly occurring crises are generally viewed as beyond leadership ability to control them while leaders are perceived to have a much greater level of culpability for smouldering crises (James and Wootten, 2005). As research by the ICM (2018) shows two-thirds of crises can be classified as "smouldering" therefore in the majority of crises leaders are perceived to be at fault. This perspective underlines the scope of crisis readiness in terms of leadership and organisational capabilities to monitor and detect crisis conditions. This is emphasised in the typological approach by Shrivastava and Mitroff (1987) which showed crises reflect human, organisational and technical failures that interact to generate a crisis. This has implications for crisis preparedness in terms of crisis awareness and understanding. Different types of economic/technical versus social/human/organisational causes are classified in Figure 3-2.

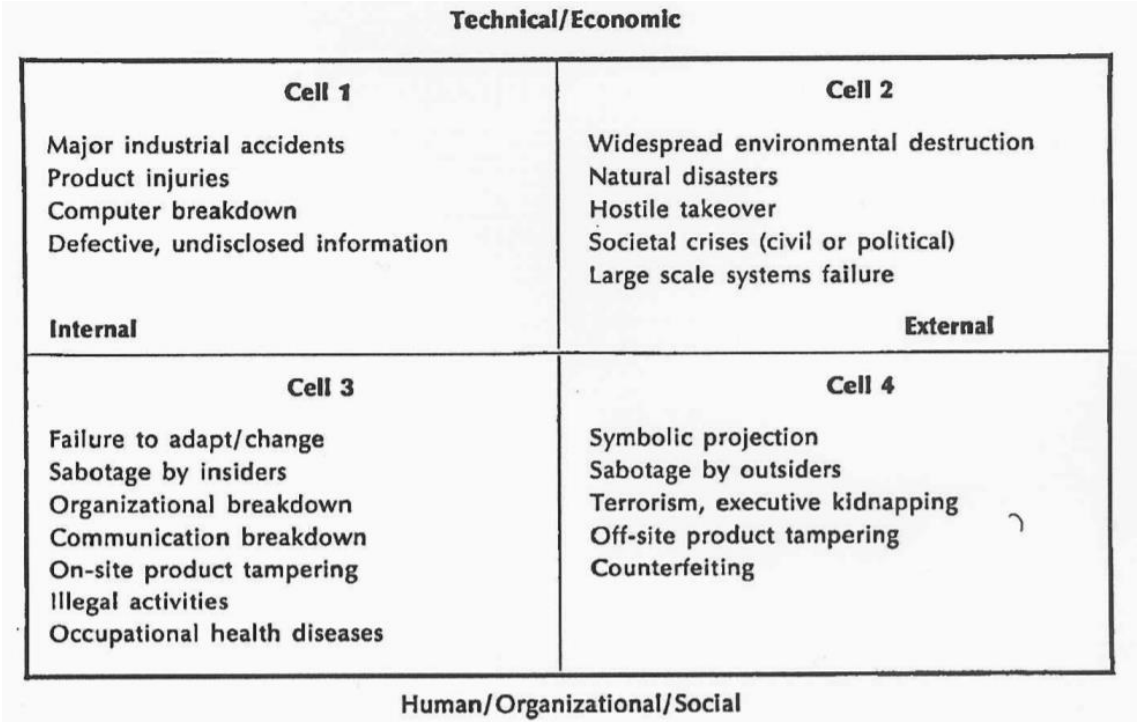

Figure 3-2 Different Types of Crisis Triggering Events

Shrivastava and Mitroff (1987, p.7).

Pearson and Mitroff's (1993) typology builds on this classification and adds further perspective on the degree of crisis in terms of "normal" or "severe". This has implication for the scope of crisis readiness and capabilities to account for different levels of severity and to address non-normal events. This is consistent with Faulkner (2001) who suggests that readiness can be undermined by inability to cope using normal routine procedures and to handle more severe or stressful scenarios. Steenbruggen et al., (2012a) find that normal structures or resources are insufficient to maintain stability in severe crisis situations. Furthermore, Gundel's (2005) classification of crises as shown in Figure 3-3 also informs the nature of crisis readiness in terms of ability to deal with a wider spectrum of crisis type. Under this view two dimensions (predictability and influenceability) can generate four broad types of crises that need to be addressed. This model when applied to road traffic crises suggests that crisis capabilities should factor conventional crises which are easily predicted and easily influenceable; unexpected crises which are unpredictable and easily influenceable; intractable crises which are easily predicted but hard to influence; or fundamental crises which are hard to predict and hard to influence (Gundel, 2005). This classification of crises suggests that crisis readiness requires measures for all four types and for different levels of severity. However while this model focuses on identifying different types of crisis in general, the focus of the present study is on crises in the specific context of road traffic that may have particular factors and antecedents that contribute to or influence crisis classification.

The relationship between crisis and disaster suggested by the literature is that a crisis can become a disaster (Al-Dahash et al., 2016). Thus while a disaster has high likelihood of causing devastation and loss of life, a crisis can escalate to disaster if it is neglected or ineffectively managed (Sawalha et al., 2013). This distinction is significant in terms of preparedness for crisis, particularly as Wilks and Moore (2004) suggest that all risks have the potential to become a crisis, and crises can be contained if managed in a systematic approach.

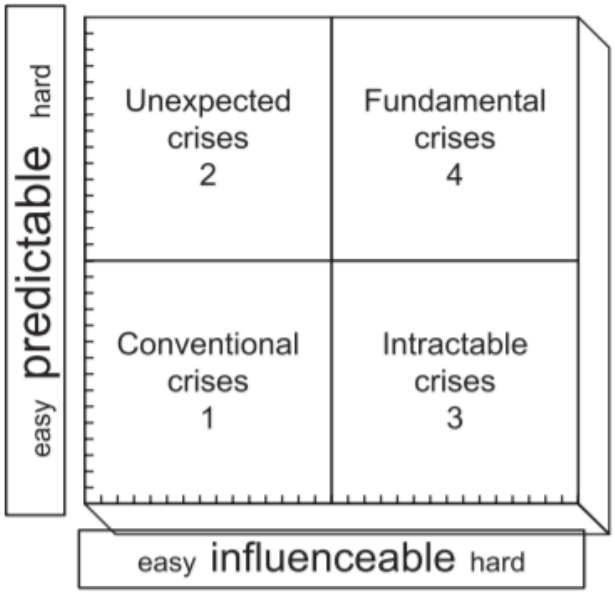

Figure 3-3 Gundel's Classification Model of Crises

Gundel (2005, p.112).

These definitions have implications for understanding the scope of crisis readiness and the factors that contribute to a state of readiness that provides effectiveness in response and containment of crises. They inform criteria for crisis readiness capabilities that account for interaction between different sources and causes of crises; identification crisis indicators; forecasting and prediction; response to different types; severity; and efficiency.

3.4 Crisis Management

Crisis readiness for road traffic can also draw on principles from broader literature crisis management. There is no definition of the term crisis management that attracts significant consensus or acceptance. An early description by Reilly (1993, p.45) identifies that effective crisis management necessitates organisational responses which are outside of the organisation's normal repertoire of management activities. Other definitions identify that crisis management is a process that aims to prevent or reduce the damage a disruptive or unexpected event may impose on organisations and stakeholders (IPR, 2007). According to Pearson and Clair (1998, p.563) crisis management "is a systematic attempt by an organisation and its stakeholders to manage or prevent crises from occurring, such that key stakeholders believe the success outcomes outweigh the failure outcomes".

Narrower definitions of crisis management can be distinguished which place emphasis on one phase of crisis response in contrast to broader, more holistic definitions which stress the significance of management before, during and after the crisis. These conceptualisations focus on three key phases of pre-crisis, crisis response, and post-crisis (IPR, 2007; Pursiainen, 2017). Crisis management can therefore be characterised as a process that is ongoing even between crises (Pursiainen, 2017).

Planning for crises has been identified in the literature as a key component associated with crisis management. Fink (1986, p.15) argues that *"*planning for a crisis, a turning point – is the art of removing much of the risk and uncertainty to allow you to achieve more control over your own destiny". Fearn-Banks (2007, p.2) define crisis management as "a process of strategic planning for a crisis or negative turning point". While the crisis response phase of crisis management is concerned with activating an actual response to crises, post-crisis phases have been characterised as a period in which review and evaluation is conducted to improve readiness for the next crisis (IPR, 2007). Pearson and Clair (1998) argue that the development of the crisis management field has largely been based on a fragmented paradigm that going forward needs to integrate three broad perspectives of psychological, socio-political and technological-structural into a unified, multidimensional perspective of crisis management.

3.5 Crisis Readiness

The concept of readiness is used interchangeably with preparedness and represents a key focus of this research. This concept has increasingly been adopted in the crisis management literature to reflect a specific state or phase in the process. Multiple frameworks and models for crisis management identify readiness or preparedness as a key component and identify key processes and elements for understanding for crisis readiness. It is reflected in different perspectives of crisis management. In Jaques' (2007) model of crisis management the pre-crisis stage is integrated as a critical relational construct that impacts on the crisis response.

Firstly, Mitroff et al.'s (1987) model characterises effective crisis management as an ongoing, dynamic process which can be entered into, and exited, at any point in the process and applied in any direction. This model emphasises a cyclical process

comprising four key phases: detection, prevention, crisis event, repair. The first phase has the most relevance for crisis readiness because it implies a process of preparation both in respect of continuous monitoring and detection. This is consistent with Fink (1986) who emphasises the importance of planning and preparedness within crisis management. Therefore, crisis readiness can be viewed as a proactive and reflection process to develop response capabilities. Despite this while many studies emphasise antecedents of effective crisis response (Light and Morgan, 2008; Subramanian et al., 2010) the concept of crisis readiness has yet to be comprehensibly defined within a single holistic model or framework. To date there has been a lack of research into this concept underlining the significance of furthering understanding of the readiness phase beyond response and recovery (Ritchie, 2009; Gowan et al., 2015) particularly in relation to road traffic crises.

In applying the concept of crisis readiness to this research context, the optimisation of the traffic agencies' response times can be evaluated from the perspective of individual and organisational state of mind "as a planned process of resource allocation and deployment" (Rousaki and Alcott 2006, p.575). In the last few decades, readiness has advanced significantly. Its role as a building block of emergency management continues and there is strong awareness that no emergency management organisation can function without a strong preparedness capability. This vital capability is built only through the efforts of planning, training and exercising (FEMA, 2001).

Different definitions of crisis readiness provide insights into the key elements and criteria for crisis readiness that may inform this research. The crisis readiness field extends over a range of disciplines and best practices in which each has its own domains of specialisation and key terms (WTTC, 2019). Across the different disciplines crisis readiness is referred to as organisational disaster readiness, emergency preparedness, emergency response, and disaster recovery (Light and Morgan, 2008; Cronin, 2015). Such terms are reflected in broader definitions of crisis readiness. An early definition by Reilly (1987, p.80) describes crisis readiness as "the readiness to cope with the uncertainty and change engendered by a crisis". Ritchie et al., (2011) defines crisis readiness as a critically important or decisive stage in the course of anything in which significant change is imminent for better or worse (Fink, 1986; OED, 2018).

The concept refers not just to a quality or state of being ready but also promptness in voluntary action and the condition of being fully prepared (OED, 2018). This condition has been characterised in multiple ways. For instance, Rousaki and Alcott (2006) highlight not only a planned process of resource allocation and deployment but also a cognitive process in terms of readiness in state of mind both at individual and organisational levels.

Sheaffer and ManoNegrin (2003) emphasises a predictive element in their definition as "a state of corporate readiness to foresee and effectively address internal or exogenous adversary circumstances with the potential to inflict a multidimensional crisis, by consciously recognising and proactively preparing for its inevitable occurrence" (p.575). Light and Morgan (2008) characterise readiness as a conscious and proactive orientation towards preparing for the inevitable occurrence of crises. In particular, they stress organisational ability to respond to different types and severity of crises and to effectively respond to and recover from major external events (Light and Morgan, 2008).

This dimension is reflected in the emphasis placed by Campbell (1977, p.13) who defines readiness as "an overall judgment concerning the probability that the organization could successfully perform some specified task if asked to do so". According to Shrivastava and Mitroff (1987) the prevention and management of crises is evidently possible but only when an in-depth understanding exists of the risks and nature of the crises. The ability to judge probability suggests crisis readiness as a process of risk assessment focused on identifying and addressing a broad list of potential uncertainties, risks and threats, accidents or errors or other types of destabilising events (Light, 2008).

On balance, these identify several key facets of crisis readiness: monitoring identification and risks and potential crises: preparedness for inevitable occurrences; cognitive readiness; both individual and organisational capability; readiness for different crises and different severities of crisis. These elements are reflected in an early conceptualisation of crisis readiness by Reilly (1987) as a construct comprising six key components: organisational capacity for rapid response to crises; both managerial awareness of and access to crisis management plans and resources; adequacy of organisational strategic crisis planning; ability to manage media during the crisis; and perceived probability of a crisis occurring to or within an organisation.

3.6 Crisis Readiness Principles

This study can be informed by a number of overarching principles drawn from crisis readiness frameworks and models. These have been developed and applied in practice to guide crisis readiness planning and preparation and include aspects such as: whole-of-society approach, joint planning and coordination, political leadership and commitment, a comprehensive multi-hazard approach and a continuous process of learning and capacity-building. While these principles are incorporated within general crisis readiness frameworks they can be drawn on for this study and applied within the specific context of road traffic crisis readiness to form the basis for a comprehensive framework in this context.

A whole of society approach built around multi-stakeholder engagement is viewed as a critical principle for providing an inclusive and effective basis for crisis readiness. This requires system interaction with government sectors at all levels of national, regional and local, the commercial sector, civil society including non-governmental organisations and the public and communities (IASC, 2013; WHO, 2017). A comprehensive approach includes integration of crisis readiness within wider national and international crisis management frameworks (IASC, 2013). Engaging at community level is considered key as communities are in the main the first responders and victims of any crisis, therefore viewed as critical members of the readiness process (WHO, 2017). This provides opportunity for shaping crisis readiness strategies which are hazard and place specific and are consistent with the needs of local communities and businesses (Sutton and Tierney, 2006). This signifies that communities should be included and represented in all activities focused on developing and implementing crisis readiness plans (WHO, 2017).

Joint planning and coordination emphasises a collaborative approach that seeks to enhance cooperation and ownership of processes rather than top-down direction, guided by those who will actually carry out the plans (Sutton and Tierney, 2006). A full range of actors including governments, agencies and NGOs need to be involved in strengthening joint planning and coordination of programmes and resources to provide reliable support based on the comparative advantage of each organisation to support crisis readiness (WHO, 2017). National leadership and political commitment is a key principle enabling effective crisis readiness. National and local governments undertake a lead role in crisis

readiness and response requiring sustained political commitment, partnerships and funding. Political leadership combined with strong national and community ownership should be accorded and maintained in addition to the creation of effective partnerships between public and private actors, technical agencies, civil society, donors, and others (IASC, 2013; WHO, 2017).

A multi-hazard approach to crisis readiness is based on the recognition that many elements of crisis readiness are common to all risks and hazards and therefore crisis readiness plans should integrate them in their design. Hazard-specific crisis readiness measures should build on and supplement all-hazard plans based on prior risk assessment (WHO, 2017). A continuous process of learning is based on the view that crisis readiness is a process rather than a product. Implicit in this principle is that all actors at all levels of crisis readiness continually seek ways to improve their plans, through identifying lessons learned from crisis events, learning from the experiences of other communities, and identifying sources of information and guidance that can be used to refine plans (Sutton and Tierney, 2006; IASC, 2013).

3.7 National Models of Crisis Readiness

While the focus of this research addresses a specific context of road traffic police response, the literature shows that local plans are informed and supported by national models and frameworks. In different countries national models have emerged to define a systematic process and steps for achieving a state of preparedness.

The Pelfrey model addresses concerns related to the absence of a consensus in a strategic process that decomposes preparedness into phases or elements to organise the crisis readiness process (Pelfrey, 2005). It is proposed that the most effective means for comprehending readiness is the utilisation of a timeline or cycle, and two different kinds of readiness cycle are identified. The “preparedness cycle” relates specifically to pre-crisis readiness based on the steps of planning, training, equipping, exercising, evaluating, and undertaking activities to correct and mitigate (Department of Homeland Security, 2004). The “Cycle of Preparedness” on the other hand is a wider approach inclusive of multiple elements that occur before, during and after a crisis (Pelfrey, 2005). Pelfrey (2005) introduces four steps in the model commencing with prevention which in turn

divides into two key phases. Collaboration is the first phase, defined in this context as combined working, training and exercising across public and private sectors, organisational levels, functions and individuals for the shared purpose of preventing crisis threats towards people and property. This definition underlines training and exercising as key elements of crisis readiness processes. The second phase of prevention is information sharing referring to a process in which information, data and intelligence is gathered, stored, analysed and disseminated among all stakeholders. This is accomplished on a need to know basis towards the goal of predicting or recognising possible crisis threats (Pelfrey, 2005). Pelfrey (2005) notes that the five separate elements in the preparedness model of collaboration, information sharing, threat recognition, risk management and intervention do not have equal importance. Collaboration and information-sharing are identified as the most necessary and critical elements of the preparedness cycle.

In the United States, FEMA (2012) adopted a general preparedness model that focused on the pre-crisis stage and crisis readiness processes. The model represents a closed, ongoing process consisting of five stages of planning, organising and equipping, training, exercising and evaluation which initiates the cycle again. Nevertheless key elements of crisis readiness fail to be integrated within the cycle including risk assessment, early warning, information/communication and public education indicating that no priority is given to communication between responders and public. This contrasts with the Pelfrey model in viewing crisis readiness as a cyclical pattern based on continuous processes that should be followed sequentially to achieve readiness (FEMA, 2012). As the model is specifically focused on early stages of emergency preparation the elements of the model have relevance for development of a crisis readiness model.

The UK crisis readiness cycle is viewed as one of the most holistic and detailed crisis readiness cycles (Alteneiji, 2015). It contrasts with the US model in including two major processes of consult and embed which function as guidelines for the readiness phase (CCA, 2004). These two processes are clearly stated to be directed by the outcomes of the risk assessment which supports the setting of objectives through all stages of the readiness phase. Once this is completed the consult process then identifies the roles and responsibilities of stakeholders required to manage the risk following which these are finalised and agreed upon. These steps are viewed as critical for facilitating the

consultation process to collectively determine the most effective approaches for addressing identified and assessed risks (CCA, 2004).

The second phase of 'embed' is based on four key steps of:

- Publishing and disseminating the plan to stakeholders and organisations that have responsibility for carrying them out (CCA, 2004); this also supports decision-making on appropriate information and communication systems and equipment and their organisation to implement the plan (Dillon et al., 2009)
- Training of key personnel based on agreed procedures which allows for evaluation and validation of the plan through exercises in preparation for the response phase
- Validation in exercise and in response
- Maintain, review and consider revision (CCA, 2004)

The Australian model is designed to address the significant variety of natural and non-natural hazards that the country faces in terms of bush fires, cyclones, storm surge and flooding, tsunami, avalanche, terrorism, tourism risks, and technological hazards (EMA, 2004). The readiness approach in this model shares similarities with Pelfrey (2005) in also encompassing the entire timeline of the crisis cycle. The elements of readiness are disaggregated into specific activities which can be easily understood and implemented. While these models of crisis readiness represent different degrees of comprehensiveness in terms of key dimensions and multiple hazards this study seeks to develop a holistic and integrated framework that incorporates a comprehensive range of dimensions and factors that can enhance and evaluate crisis readiness.

3.8 Crisis Readiness Frameworks

In addition to national models, a review of the literature reveals key crisis readiness frameworks, models and instruments that provide insights into principles and core components. Four prominent frameworks have been reviewed, developed by international or national institutions and agencies responsible for crisis or emergency response or which have been developed from systematic review. A humanitarian approach is emphasised based on human rights norms and which underpins the operationalisation of the framework. The model provides a systematic approach based on eight key components to collectively assess capabilities and needs and develop and implement programmes and plans to enhance preparedness. A humanitarian approach is emphasised based on human rights norms and which underpins the operationalisation of the

framework. The model provides a systematic approach based on eight key components to collectively assess capabilities and needs and develop and implement programmes and plans to enhance preparedness.

Table 3-4 outlines the key characteristics and contexts and sources for the most widely cited crisis readiness frameworks.

The Common Framework for Preparedness is a disaster risk management framework developed by the Inter-Agency Standing Committee and the United Nations (IASC, 2013). This enables international and regional actors to cooperate with governments and national institutions. A humanitarian approach is emphasised based on human rights norms and which underpins the operationalisation of the framework. The model provides a systematic approach based on eight key components to collectively assess capabilities and needs and develop and implement programmes and plans to enhance preparedness.

Table 3-4 Crisis Readiness Frameworks

Name	Source	Context	Type	Principles
Common Framework for Preparedness	Inter-Agency Standing Committee (2013)	National disaster risk management	Framework	National leadership; joint planning and coordination; international human rights law; combined humanitarian and development expertise; comprehensive approach; context specific
Capability Assessment for Readiness (CAR)	FEMA (2001)	State-wide disaster response preparedness	Survey Instrument	Operational readiness and capabilities to: mitigate, prepare, respond and recover
Sutton and Tierney (2006)	Sutton and Tierney (2006)	National disaster emergency preparedness	Systematic Review	Comprehensive preparedness strategy; continuous process incorporating learning mechanisms; realistic; collaborative; inclusive; multi-organisational; overcome challenges and barriers; risk-based; focused on all-hazards
Strategic Framework for Emergency Preparedness	World Health Organisation (2017)	National and international health emergency preparedness	Framework	Safeguarding communities; community-driven; political commitment, partnerships, and funding; risk assessment and management; mutually-reinforcing systems; all-hazards approach; inclusiveness

The Capability Assessment for Readiness (CAR) (FEMA, 2001) is a survey instrument developed by the US Federal Emergency Management Agency (FEMA) to assess state capabilities and operational readiness for mitigation, preparedness, response and recovery from emergencies and disasters. Thirteen emergency management functions are identified measured using national level performance criteria.

Sutton and Tierney (2006) proposed eight dimensions of preparedness for households, businesses and communities and organisations. These drew on a systematic review of diverse practitioner, government and academic sources on preparedness and planning including research instruments, preparedness guidance and checklists, guidance from federal agencies, best practices, and scholarly and business journals. The authors identify preparedness as a continuous and proactive process that incorporates learning and broad engagement.

The Strategic Framework for Emergency Preparedness (WHO, 2017) is an internationally applicable framework developed by the World Health Organisation (WHO) to address health emergency preparedness. This is based on strong principles of political and community engagement and commitment. Key elements grouped around three main areas of governance, capacities and resources support the determination of priorities and the strengthening of operational capacities.

3.9 Road Crises

A review of the notion of road traffic crises underlines the different capabilities that impact on readiness. Road traffic crises, as with many different types of crisis and emergency, have specific characteristics which require consideration when seeking to address and respond to them. Road crises can have a direct impact related to loss of life, injuries and property damage and or severe impact on the reliability and mobility of transport systems (Steenbruggen et al., 2012a).

There is recognition that road traffic crises are a distinct form of crisis that requires distinctive readiness in respect of organisation and operational processes (Steenbruggen et al., 2012a). Traffic incident and crisis management or Traffic IM is widely regarded as a planned, coordinated, and multi-disciplinary process involving cooperation between multiple public agencies and private sector partners that focuses on identifying and

responding to traffic incidents in order to restore normal traffic flows as rapidly and safely as possible (Steenbruggen et al., 2012a; USDoT, 2020). Definitions of traffic incident define it as *"*an unforeseen (unpredictable) event that impacts on the safety and the capacity of the road network, and that causes extra delay to road users" (EasyWay, 2011) or as "any non-recurring event that causes a reduction of roadway capacity or an abnormal increase in demand" (USDoT, 2020).

By drawing on the crisis literature for the purpose of this study a road traffic crisis can be defined as an unanticipated or unpredictable occurrence that impacts on the safety and the capacity of the road network. This definition is based on the assumption that, while traffic incidents are generally bounded by restriction to the specific locale of a road network and impacts on its safety and capacity (Easyway, 2011), crisis and disaster events by contrast can be characterised as complex and unpredictable, and in which responses are implemented under conditions of high uncertainty, significant time pressures, and requiring the cooperation of multiple different professional groups (Comfort and Kapucu, 2006; Lee et al., 2011).

Literature and practice reflect this assumption and identify specific approaches and strategies to address road traffic crises. For example while the goals of traffic IM focus predominantly on safety and mobility on road networks, crisis and disaster management has broader priorities in terms of safeguarding national safety and security (Lee et al., 2011). In respect of organisation, differences with crisis management exist in terms of interaction with a smaller number of actors and greater hierarchical, directive control focused on specified tasks. In contrast with traffic incident management, crisis and disaster management requires less traditional, more flexible forms of control to address more volatile and dynamic conditions (Comfort and Kapucu, 2006).

3.9.1 Road Traffic Management

The concept of road traffic crisis readiness can be evaluated in terms of key organisational and inter-organisational structures and processes. Within the literature traffic incident management (IM) and broader crisis or disaster management can be distinguished by differences and overlaps in a number of key aspects such as definition, type of event, goals, organisation, communication, coordination, resources and processes.

Dimensions of traffic incident management overlap and are incorporated within the wider concept of road traffic crisis management.

Evaluation of crisis readiness in terms of the level of co-operation between the different actors in the IM system is underlined by the fact that the organisation of transportation operations and public safety operations can overlap and intersect in many areas. This encompasses a wide range of organisations responsible for traffic IM including public emergency services such as the police, fire brigade, and ambulance and medical services, road and transportation authorities and private sector organisations whose primary tasks are towing, repair and insurance services (USDoT, 2020).

The degree to which organisations co-operate effectively is embodied in principles of traffic incident management as a planned, coordinated and multi-disciplinary process (USDoT, 2020) capable of responding to continuously unfolding and dynamically changing situation in terms of scope, impact and urgency, the types of appropriate responders, and needs for information and communication of key stakeholders (Janssen et al., 2010). Readiness can also be evaluated in accordance with respective organisational roles. For instance, public safety providers promote consistent and safe transportation through supporting accident prevention and the rescue of accident victims. Conversely, transportation operations and networks facilitate access to accident locations for emergency services and increasingly supply real-time information on road and traffic conditions (Steenbruggen et al., 2012a).

Thus, from a process perspective crisis readiness can be evaluated in relation to a range of capabilities and resources. A traditional IM cycle emphasises response and recovery phases in respect of detection, verification, warning, followed by response, driving, arrival, operational actions, normalisation and flow recovery (Zwaneveld et al., 2000). A conventional crisis or disaster management cycle describes processes for pre-response phases and generally comprises four key stages of mitigation, preparedness, response and recovery (Doherty, 2009). The Netherlands implements a simplified cycle comprising four key phases of alerting, response and arrival, action, and normalisation to manage traffic incidents (Steenbruggen et al., 2012b). In Europe initiatives have also existed which aim to create a shared agreement on the process phases for traffic IM (CEDR,

2011). Practice appears to show that traffic IM is frequently a subset or subsumed within overall disaster management frameworks.

These processes are critically underpinned by communication systems and processes which reflect further criteria for crisis readiness. While smart technologies and mobile communications have generally been integrated within traffic IM, voice communications such as radio remain key elements of local first responder IM communication systems (National Traffic Incident Management Coalition, 2006). Disaster and crisis management communication however differs in several respects associated with higher levels of uncertainty and increased need for adaptability and flexibility in communications strategies, means and operations (Arroyo-Barantes et al., 2009). Furthermore there are differences in terms of the impacts on resources between the two levels of crisis: for IM, resources such as roads and facilities are generally intact and management structures are typically adequate to coordinate the number of resources required (Auf der Heide, 1989); for crises and disasters, some transport networks may be unusable and communications networks damaged or destroyed, and resources may exceed management capacity (Auf der Heide, 1989).

3.9.2 Road Crisis Classification

The preceding discussion has emphasised significant facets of crisis readiness for the road traffic context. These capabilities can also be evaluated in accordance with different types of road crises. The literature and practice identify that the scope and severity of traffic incidents occur along a continuum from small-scale, daily incidents to more serious occurrences that reach the level of emergency or even disaster events (WRA, 2019).

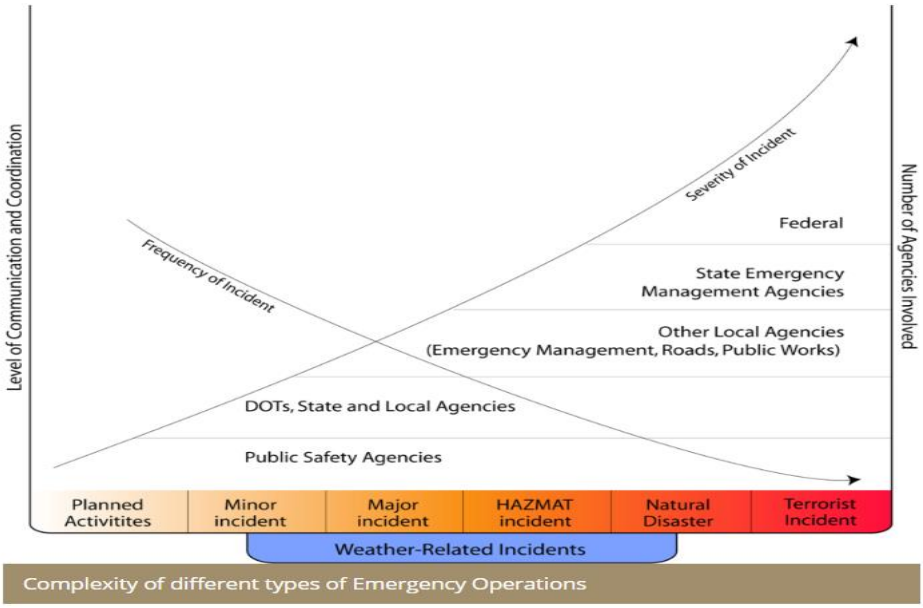

Figure 3-4 Road Traffic Incident Continuum
Source: World Road Association (2019).

According to the World Road Association (WRA, 2019) as the severity of the incident increases along this continuum responders and managers change and the size of the team expands. This process is depicted in Figure 3-4 which shows that those agencies affording oversight and support will change with increasing seriousness to involve other stakeholders such as emergency managers, state and national agencies (WRA, 2019). This suggests that the greater the severity of the incident the greater the level and communication and co-ordination and number of agencies involved. Conventional practice indicates the assignment of an Emergency Coordination Centre from among the frontline responders and frequently a Traffic Control Centre is considered to be the best position to adopt that role.

In terms of understanding of the scale of the response needed and how this can be prepared for and evaluated the WRA (2019) proposes a perspective as shown in Figure 3-5 based on considering the extent of public preparedness for the level of incident in comparison with local and national preparedness. While the term “incident” is employed for all levels of severity the agencies involved and extent of their response increases from left to the right side of the figure.

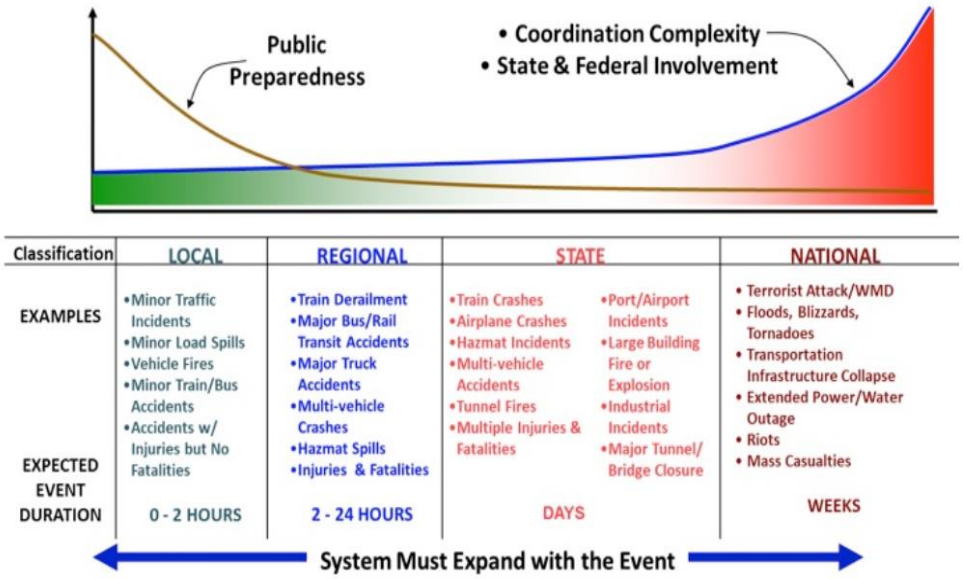

Figure 3-5 Classification of Incidents based on Coordination Complexity and Level of Public Preparedness
World Road Association (2019).

A number of tasks are associated with planning for major road emergencies which constitute the regional, state and national events depicted in Figure 3-5 and which can be devolved into different stages (WRA, 2019). Firstly the types of incidents likely to expand into a crisis are defined followed by identification of partners and joint definition of missions. Review of communications and validation of operational organisation form key stages, in addition to training of crisis response managers and exercises to test organisational arrangements and procedures, and to train staff.

3.10 Antecedents of Traffic Crisis Management

The literature has identified a range of antecedents and factors that positively or negatively impact on effective traffic incident management. A major antecedent given the emphasis placed on this element is the extent to which cooperation exists between different actors in the traffic IM system. In many studies and evaluations, information, communication and coordination are found to be the main facilitators or barriers impacting effective cooperation between crisis response actors (Comfort and Kapucu, 2006; Chen et al., 2008). European research on emergency response plans in different domains reveals that increased information and improved understanding of hazards and their impacts is required, and emergency planning processes would be enhanced by

greater information sharing and engagement (Lumbroso et al., 2012; Lumbroso and Vinet, 2012). This suggests the significance of information technology and the assimilation of new information concepts to enhance information sharing and decision-making processes for crisis responders.

In particular there is substantial evidence to indicate that interagency information sharing is a significant antecedent for achieving the most efficient, rapid and effective response to traffic incident or road traffic crisis from all relevant agencies (Turoff et al., 2004; Lee et al., 2011; Steenbruggen et al., 2012a). Agencies that are responsible for public safety and those for road transport frequently possess information that is important and beneficial for each other's operations such as road situation information, incident detection and alert, site status of the incident and information for coordination (US NCHRP, 2004). Informed decision-making and the formulation of responses is acknowledged to depend on the availability of accurate, relevant and timely information (Grothe et al., 2005). In turn this is reliant on information technology to enhance information sharing and decision making for emergency responders and enable inter-organisational information sharing (Graves, 2004). Turoff et al., (2004) outline fundamental principles for the success of crisis response information systems and key roles that such a system should support.

However research indicates that information sharing between crisis response agencies is still very much in its infancy in terms of development, and can hinder the effectiveness of interagency crisis response activities. Historically emergency services organisations have developed information systems to support their own specific IM responsibilities and operations and which are characteristically closed systems (Steenbruggen et al., 2012a). Moreover emergency service agencies have traditionally relied on basic telecommunications services such as landline and mobile phone calls to alert and share information inter-organisationally. Issues have been identified even within organisations in relation to system architectures, standards adopted and system diversity (Steenbruggen et al., 2012a). Major questions remain in terms of the quality of information shared and challenges in identifying and displaying it when needed (Lee et al., 2011). The Netherlands has one of the highest population densities and traffic congestion rates in Europe, and has made concerted efforts to establish an effective traffic incident

management system in Dutch cities. Official evaluations have identified two key information problems undermining effective inter-agency incident response (ACIR, 2005). Issues existed in relation to the accessibility and availability of accurate and comprehensive information for IM response agencies, in addition to a failure to ensure shared access to information between different emergency services (ACIR, 2005). This is consistent with a model of crisis response coordination by Passenier et al., (2012) incorporating a taxonomy of identified information barriers which highlights four key areas of coordination practices, communications networks, situational properties, and information systems and communication system.

Literature reveals moreover that traffic crisis response agencies have a range of different information needs which play a critical part in promoting effective management of traffic incidents. Failure to address or optimise inter-agency information sharing in respect of these different needs is likely to impact the overall quality of incident management. Information requirements for traffic IM have been categorised into three primary groups of incident, surrounding environment, and organisation intelligence (Steenbruggen et al., 2012b). Distinction has also been made in practice between semi-static, dynamic, and model information in which the information components that support crises and large-scale emergencies are classified into eight different categories (ACIR, 2005). Steenbruggen et al., (2012b) further characterise the diverse information needs in this context as nearly all containing a geospatial element. The authors propose that the enhancement of situational awareness for traffic crisis response organisations depends on real-time availability of different kinds of information. Examples include location information, such as where the incident is located, and road user and emergency service locations, in addition to quantitative data such as the number of people involved, and information on the causes and any safety risks for surrounding areas (Steenbruggen et al., 2012b).

Widespread practice across different countries points to the importance of integrating different types of information within a Common Operational Picture (COP) to enhance collaboration and cooperation among often geographically distributed agencies and organisations (Tierney, 2007). A COP is established and sustained by collecting and collating, synthesising, and disseminating incident information to all relevant actors

(Tierney, 2007; Steenbruggen et al., 2012a). The achievement of a COP is purported to enable both on-scene and off-scene crisis responders to have the same information about the crisis, including information on the accessibility and location of resources to support cooperation and multi-agency working (Tierney, 2007). It also holds information on the status of assistance requests, the emergency response activities, the incident itself and the results of specific measures. A model by Dutch agency ACIR (2005) of a crisis management COP provides an overview of the key categories of information which should be included: object information; planning information; citizen information; geo-information; capacity information; effect information; activity information, and prediction information (ACIR, 2005).

The main goal of a COP is to enhance the situational awareness (SA) of crisis response actors on the ground and in operations centres (Steenbruggen et al., 2012a). Situational awareness is defined as the apprehension of elements and events in the environment with respect to time and space, understanding of their meaning, and the projection of their future status (Endsley, 1995). In more general terms, it refers to "knowing what is going on around you" (Endsley and Garland, 2000). Both concepts are identified in the literature as key elements of a "net-centric" approach to information operations to enhance inter-organisational cooperation towards a common goal (Boyd et al., 2005). A number of research studies have evaluated a net-centric approach in the context of traffic IM and crisis management. A key conclusion is that while effective cooperation is highly dependent on a COP and shared situational awareness they are not sufficient to ensure it, and a level of collaboration or organisation awareness is also necessary (Treurniet et al., 2012). Three key conditions for collaboration awareness are identified of predictability, accountability and shared understanding (Treurniet et al., 2012).

Research has identified a range of barriers to and requirements for effective implementation of a network centric approach to improving cooperation based on SA and COP (van de Ven et al., 2008). van de Ven et al., (2008) suggest that the benefits of this approach can only be achieved if training is implemented to enlarge people's capabilities to collaborate in a network. Bharosa et al., (2010) point to the necessity of considering a range of barriers at different levels, finding that there is no one distinct factor that hinders or promotes information sharing and coordination which is impacted by impediments at

individual, community, and agency levels in relation to institutional and technological elements. The findings show that resolving obstacles at one specific level only may not necessarily enhance overall information sharing and coordination and obstacles need to be addressed at all levels simultaneously (Bharosa et al., 2010).

3.11 Cultural Factors in Crisis Readiness and Response

Literature shows that culture can have an impact on emergency behaviour and how people perceive and respond to crises and disasters (Galea et al., 2013; Shiwakoti et al., 2020). Therefore crisis management and crisis response concepts developed predominantly in Western contexts may not be universally applicable across different cultures and regions. Culture can be defined as a coherent system that subsumes beliefs and values, rituals and traditions and the artifacts that manifest them (Hallahan, 1997). Hofstede (1980, p.25) defines culture as "the collective programming of the mind which distinguishes the members of one human group from another". Hofstede (1980) argues that cultural differences can be explained across key dimensions such as uncertainty avoidance, power distance, and individualism.

Culturally bounded assumptions, beliefs and norms can significantly influence how different communities frame and interpret hazards and disasters and therefore how they react to and cope with crises both in the short and long-term (Koentjaraningrat, 1985; Dibben, 1999; Cornia et al., 2014). Findings of an in-depth cross-cultural investigation of population evacuation behaviour found differences across four distinct cultures in terms of response times, action tasks undertaken, information tasks undertaken, and duration of these tasks (Galea et al., 2013). Studies have shown that cultural factors can influence individual behaviour and cognition across a range of crisis dimensions such as risk perception (Prati et al., 2013; Cornia et al., 2016), evacuation behaviour (Galea et al., 2013; Shiwakoti et al., 2020), coping strategies (Wickrama et al., 2017; Shiwakoti et al., 2020), prevention knowledge (Galea et al., 2013), safety culture habits (Galea et al., 2013) and post-crisis trauma (Perilla et al., 2002; Wickrama et al., 2017). Cornia et al., (2014) show that cultural differences can emerge across three dimensions of crisis perception: disaster framing, trust in authorities and blaming. Shiwakoti et al., (2020) show that airport passengers' coping strategies during an evacuation event affected their perceived likelihood of a safe evacuation, and that significant differences existed across different

cultures in the perceived ability to evacuate safely. This suggests that consideration should be given to how culture shapes the perceptions and coping strategies that individuals employ in a crisis. Cultural factors can also impact the way in which individuals respond to stress, engage in managing crises and access crisis relief efforts (Jogia et al., 2014). This has significant implications for the management of crises and implies a diverse and culturally specific approach to crisis readiness and response

Few studies have examined how cultural factors influence peoples' response to the specific context of road traffic crises. On the other hand there is evidence to show that cultural differences exist in relation to perceptions of road traffic risk, attitudes towards traffic safety and driving behaviour (Lund and Rundmo, 2009; Njordfjaern et al., 2012; Njordfjaern et al., 2014; Sucha et al., 2016). One cross-cultural study shows that cultural factors were stronger predictors of driver behaviour than of risk perception, and further that countermeasures targeted to influence social cognition in relation to risk perception and attitudes could have stronger applicability in countries possessing a more individualistic and western cultural orientation (Njordfjaern et al., 2014). Cultural religious factors have also been identified as influential in shaping driver attitudes and perceptions. In particular Islamic and Arabic drivers are shown to be more fatalistic than drivers from other cultures that can contribute to more harmful driving habits (Kayani, 2011; Ekmekci, 2019). This may have consequences for road traffic crisis readiness as fatalism has been shown to undermine levels of preparedness for natural disasters (Baytiyeh and Naja, 2016).

Cultural factors can also impact how organisations prepare for and respond to crises. Arab culture has high power distance (Hofstede, 1980), in which there is acceptance of the role between managers and subordinates and reliance by subordinates on being told what to do by leaders (Obeidat et al., 2012). The UAE is further identified as highly uncertainty avoidant where management is formalised and an environment exists in which innovation is limited by rules (Hofstede, 2001). These factors can influence how first responders act in the field when responding to a road traffic crisis. Moreover culture can impinge on collaboration and knowledge-sharing practices among organisations and emergency responders which can affect the quality of response. In the UAE these practices may be constrained by a closed culture and an emphasis on secrecy and trust as

prerequisites for sharing information (Al-Esia and Skok, 2015; Mohamed et al., 2008; Weir and Hutchings, 2005). Arabs need to develop a strong sense of security before sharing their knowledge which often may only occur between individuals with kinship through family ties and close connections (Weir and Hutchings 2005).

These differences underline the relevance of a culturally sensitive approach to crisis readiness and response. FEMA (2011) suggests that assessment of the cultural characteristics of a community can help responders to anticipate potential attitudes in crisis situations. A cultural approach can help to identify and deploy appropriate methods and is associated with continuous learning, coordination and communication among diverse populations (Bergeron, 2014).

3.12 Conclusion

This chapter presented a review of the literature focused on conceptualising and defining the key concepts, dimensions and components of crisis readiness. A review of theory and models of crisis management and emergency preparedness in praxis establishes a theoretical basis for key elements and measures. There was scarcity of research into the operationalisation of these dimensions and the consensus of each of the dimensions varied underlining a research gap and potential for significant contribution. A review of crisis readiness principles, national frameworks of crisis management and crisis readiness frameworks resulted in identification of sixteen dimensions and wide range of performance indicators. While the strength of evidence and consensus varied significantly across the literature those identified in this review have sufficient theoretical basis to be adopted within the conceptual framework that can be subject to evaluation and verification in this research. The next chapter presents the conceptual framework for this study and the theoretical basis for each component.

CHAPTER 4: CONCEPTUAL FRAMEWORK

4.1 Introduction

The review of the literature underscored gaps in a holistic and integrated strategic framework for crisis readiness for law enforcement agencies. The conceptual framework formulated and presented in this chapter draws on the key elements identified in the literature that can inform exploration and validation of a strategic framework for crisis readiness and index of performance measures. The theoretical basis of crisis readiness draws on national models and frameworks for crisis readiness that defines sixteen different dimensions of crisis readiness and associated performance indicators. The framework provides the basis for empirical and qualitative evaluation and verification to establish and prioritise the key components of a comprehensive model of crisis readiness.

4.2 Key Components of Crisis Readiness

The conceptualisation of crisis readiness draws on the principles and knowledge identified in the theory and praxis. The concept of crisis readiness is embedded both explicitly and implicitly in the theory of crisis management, in concepts and principles of readiness and preparedness identified in the literature and in national and theoretical frameworks. The national frameworks and models of emergency preparedness address the concept of readiness to varying degrees and reflect an intersection of theory and practice. Notably, few models and literature directly address and operationalise crisis readiness and its key elements. The conceptual model proposed in this chapter draws on a comparison of the models outlined in Table 4-1 which reveals the convergence around a number of components towards an initial comprehensive, multidimensional conceptualisation.

Each of the frameworks reviewed are based on a specific set of components that underpin crisis readiness or preparedness. Five principles appear consistently in all models: inclusiveness, comprehensiveness, collaboration, multi-organisational partnerships, and joint planning and coordination. Inclusiveness integrates a whole of society approach built around multi-stakeholder engagement and system interaction with government sectors at all levels of national, regional and local, the commercial sector, civil society including non-governmental organisations and the public and communities

(IASC, 2013; WHO, 2017). A comprehensive approach includes integration of crisis readiness within wider national and international crisis management frameworks (IASC, 2013). Joint planning and coordination emphasises a collaborative approach that seeks to enhance cooperation and ownership of processes rather than top-down direction, guided by those who will actually implement the plans (Sutton and Tierney, 2006). Multi-organisational partnerships underline the involvement of a full range of actors including governments, agencies and NGOs in strengthening planning and coordination of programmes and resources to provide reliable support based on the comparative advantage of each organisation to support crisis readiness (WHO, 2017). These principles are shown to underpin how the different key components of crisis readiness are implemented.

Several components are represented in the majority of the frameworks: risk assessment, resources, coordination, information management and communication, response planning, training, exercises, logistics and facilities, public education and legal and institutional frameworks.

Table 4-1 Key Components of Crisis Readiness Frameworks

Components of Crisis Readiness	Common Framework for Preparedness (IASC, 2013)	Capability Assessment for Readiness (FEMA, 2001)	Sutton and Tierney (2006)	Strategic Framework for Emergency Preparedness (WHO, 2017)
Risk Assessment				
Resources				
Coordination				
Information Management and Communication				
Response Planning				
Training				
Exercises				
Logistics and Facilities				
Public Education and Information				
Legal and Institutional Frameworks				
Hazard Management				
Early Warning				
Recovery Initiation				
Operations and Procedures				
Property Protection				

= included

The Capability Assessment for Readiness provides by far the most comprehensive set of components that are shared with other frameworks. The theoretical bases of each of these components in the wider literature are now discussed in the following sections.

4.2.1 Risk Assessment

Risk assessment may have significant relevancy for crisis response times by identifying and assessing the probability and impact of potential crises and shocks, efforts and resources. Response times for traffic crises can be optimised by addressing the likeliest and highest priority risks to support planning and response crisis teams and deployment of resources (WHO, 1998). Risk assessment is common to all the frameworks and focuses on identification and evaluation of hazards and risks, vulnerabilities and capacities to determine priorities for emergency preparedness (IASC, 2013; WHO, 2017).

Hazards are identified as situations or conditions that could cause injury or damage to people, property and infrastructure and the environment, and impact government and operational continuity (FEMA, 2001; Sutton and Tierney, 2006). A range of different tools are proposed for the analysis of the probabilities of specific hazards occurring such as scenario and historical analysis, event risk assessments, forecasting and modelling and loss estimation software (FEMA, 2001; Sutton and Tierney, 2006; Ikeda, 2010; WHO, 2017). There is consensus in the literature on the importance of community participation in the risk assessment process specifically in supporting multi-hazard, multi-sectoral and multi-level risk and capacity assessments (CCA, 2004; Nagasaka, 2006; Ikeda, 2010; WHO, 2017).

The communication of risk is identified as a critical element of the risk assessment process to ensure risk information is effectively communicated to all stakeholders at community and national levels (CCA, 2004; Alexander, 2009; WHO, 2017). This alludes to inclusiveness in terms of multi-stakeholder engagement that provides an inclusive and effective basis for crisis readiness. Two categories of stakeholders have received highest attention in terms of risk communication: the public, and crisis responders. Raising public awareness of crisis risks involves two key aspects of crisis readiness communication. Firstly the public is made aware of how the emergency sector plans to manage crisis risks when they occur and secondly, they are provided with early warning and the information

and advice necessary for the beginning of crises (CCA, 2004). Evidence has indicated that the effectiveness of the response process is enhanced by a more informed public in terms of the risks and associated activities for risk mitigation and reduction in the event of a crisis (Alexander, 2009). Crisis responder responsibilities in this area are noted to be sequentially related to assessing risks, documenting plans and disseminating the information of relevance to the public to raise awareness and assist preparation (Brito, 2012).

4.2.2 Resources

The availability and accessibility of financial, technical and human resources are identified as critical factors both in terms of building a state of crisis readiness and to support allocation and deployment of response teams, technical equipment and other resources (Kovoor-Misra, 1995; Hoffer Gittel et al., 2006; Light and Morgan, 2008; Zemp, 2010; WHO, 2017). Resources can have a major and direct influence on the ability of road traffic agencies to respond appropriately in order to mitigate the worst impacts of a crisis on human life and property (EU, 2018). This component is identified in all frameworks and is concerned with appropriate resource allocation to ensure coping capacity and to enable the availability and accessibility of funding for crisis response (Sutton and Tierney, 2006; IASC, 2013; WHO, 2017).

Research has highlighted the significance of adequate funding as the basis upon which all other attributes of reliable crisis response depend (Frederickson and LaPorte, 2002). This aligns with the principle of national leadership and political commitment noted across the frameworks (IASC, 2013; WHO, 2017). The rapid and timely availability and commitment of financial resources are recognised as key to enhancing crisis readiness and contribute to organisational resilience in a crisis event (Kovoor-Misra, 1995; HofferGittel et al., 2006). The IASC (2013) framework underlines the importance of international funding arrangements as well as core country emergency budgets and risk pooling mechanisms. This extends to the need to ensuring that mutual aid agreements at all levels are established and in place (FEMA, 2001).

Technological and physical resources and facilities represent a second major element identified in the literature (Light and Morgan, 2008; Zemp, 2010; Collins et al., 2016). The availability of appropriate systems and equipment that alert, dispatch and convey

crisis teams to the scene swiftly is vital for optimising response times. To enhance crisis response times key resources include contact and dispatch centres, communications systems, transportation, supplies and equipment and information technology support such as GPS. Some models identify the importance of the acquisition, storage, distribution, accounting, and use of internal and external human and material resources and supplies to support response activities (FEMA, 2001; Sutton and Tierney, 2006). Location and resources issues have been identified as key barriers in crisis communications. A lack of or insufficient training with communications systems can impede communications in crisis response as responders do not have the knowledge to use the system efficiently (Gomez and Turoff, 2007).

A third element of the resources component addresses the importance of human capital where crisis readiness and response is contingent on the composition of skilled and well-trained personnel (Sutton and Tierney, 2006). FEMA (2001) considers that the systematic development of methodologies is key to effective resource planning to enable the timely and effective identification of resource needs and hidden resources. The establishment of alternate resources and facilities and operations centres is also noted to ensure crisis resilience (FEMA, 2001).

4.2.3 Coordination

Coordination is a recurrent theme in the crisis readiness literature across all the models. Rapid response requires effective communication patterns and the coordination of resources, equipment, and skills to enable seamless collaborative action (Abbasi et al., 2018). This is characterised in terms of government coordination mechanisms, leadership structures and inter-agency coordination at all levels and across sectors (IASC, 2013; WHO, 2017). This reflects principles of collaboration, multi-organisational partnerships and joint planning. Four key aspects of co-ordination are emphasised: organisational structure, decision-making process, interagency arrangements, and stakeholder relationships.

The development of organisational structures defining the roles and responsibilities assigned to specified crisis readiness individuals and teams is a consistent theme (Shrivastava and Mitroff, 1987). Borges et al., (2011) show that roles in crisis response systems are characteristically categorised into first responders such as police and

ambulance crews and different command structures. Command Centres are frequently accorded the highest authority and make strategic decisions. On the front line, incident commanders and other professionals adapt their response according to the current situation, managing local resources and limitations, evaluating risks, making decisions and keeping abreast of operational progress. Grigg (2003) advocates a matrix management structure that incorporates a specific set of lines of authority for crisis readiness and response. Hofmann (2007) emphasises responsibility and ownership for crisis readiness by each area.

Light and Morgan (2008) advance a set of specific structural characteristics:

- Assigning responsibility to a specified individual or team
- Maintenance of chain of command while sharing authority and empowering subordinates
- Creation of efficient and flexible decision-making processes
- Organisation of rapid, efficient and accurate communication flows
- Emphasis on continuous learning and improvement
- Generation of strong teams and their effective management
- Organisational culture that values crisis management and resiliency
- Promoting development of creative solutions

Sharing authority across crisis readiness structures and systems is described in terms of delegating authority and empowering subordinates to undertake independent action (Perrow, 2011). This is a critical element in the crisis readiness literature as fast-paced operational demands are recognised to require flexible and rapid decision-making processes for operational teams and decentralised, cooperative patterns of authority (Frederickson and LaPorte, 2002). Evidence shows that while crisis readiness structures possess formal chains of command these hierarchies do not function at all times (Frederickson and LaPorte, 2002). Shared decision-making has been linked in the literature to enhanced organisational resilience (Shrivastava and Mitroff, 1987).

Interagency arrangements represent a further aspect of co-ordination emphasised in the literature. The Common Framework coordination component extends this beyond national scope to define the roles and responsibilities of international partners (IASC, 2013). Thus the extent to which major road crisis responses require external expertise or specialist support and how their actions are integrated as far as possible with existing coordination mechanisms and national priorities is a key element. FEMA (2001)

identifies the importance of training and developing the capabilities of key organisational crisis actors to direct, control and coordinate response and recovery operations which can involve coordination across multiple agencies and jurisdictions. The significance of developing coordination capabilities is underlined in research by Alfahid (2006) examining the nature of the coordination among crisis agencies in Saudi Arabia. While finding that overall coordination was high there a major challenge was a failure to incorporate development and improvement tools and approaches within coordination processes.

The management of relationships with stakeholders is a further attribute of coordination (Grigg, 2003). Stakeholders are individuals, groups and organisations who have the ability to influence or are affected by a crisis. Different co-ordination mechanisms are proposed in the frameworks to promote integration across different agencies by forming networks and committees (Sutton and Tierney, 2006; WHO, 2017) and ensuring inclusive participation of key private and civil society organisations and leaders and relevant sectors (WHO, 2017). Planning for interorganisational as well as intra-organisational coordination is viewed as important and includes the early involvement of external experts (Grigg, 2003). Communication is identified as a key theme in this area (Johnson, 1990). In this regard the literature emphasises that crisis readiness structures should be organised to facilitate rapid, open and frictionless communication both internally and externally and in ways that minimise miscommunication among stakeholders (Pearson and Mitroff, 1993). Establishing networks and linkages essential to coordination and facilitating information flows that can enhance the speed of crisis response is a major consideration.

4.2.4 Information Management and Communication

Information management and communication are identified as a further vital element in rapid response. Information assumes a central role in initiating response activities, assessing an appropriate response and more widely ensuring effective crisis readiness (Stal, 2013). The literature converges on the key goal of achieving rapid dissemination of crisis communication in a timely response that minimises the impacts of the crisis. Central to most models is the development of information management systems and communication systems at sector, national, regional and international level (FEMA,

2001; IASC, 2013; Collins et al., 2016). The literature converges around five key elements: communication systems; ICT technologies; information gathering and dissemination: data analysis and simulation tools; and communication response.

The overarching goal is for communication systems and procedures to facilitate the accurate and timely dissemination and response to requests for pre-crisis, crisis, and post-crisis information from employees, first responders, the public, and the media. A key element of communication noted in frameworks is the development of communication planning and preparedness including regular testing and support and addressing the interoperability of communications systems (FEMA, 2001; Sutton and Tierney, 2006). Effective coordination of communication flows is considered to be dependent on both the level of interaction necessary for managing the crisis and the appropriateness of the information system used to communicate between crisis managers, responders and the public (Alexander, 2002). Interoperability within a secure boundary between different crisis-related information and communication systems is identified as a key aspect. Online environments within secure systems architectures are being developed and deployed in crisis management such as CIS, a pan-European crisis environment for communication and information exchange that includes a cloud-based Pan European Information System (Kuhnert et al., 2015), and MIKIoBOS, a mobile ICT system for crisis response (Verma and Sehgal, 2016).

Multiple frameworks identify the development of reliable crisis communications capability to alert emergency authorities, warn the public and effectively manage crisis response (FEMA, 2001; WHO, 2017). The WHO (2017) framework advocates the integration of both surveillance systems and accessible, available, quality databases for emergency preparedness for effective information management. Maintaining early warning systems that can provide detailed information for ensuring public safety is considered key (Brito, 2012). In crisis situations competition for constrained resources among response organisations has further been evidenced to hamper communication (Perry, 2007). The experience of past crises including the 9/11 attack in the US and the London 7/7 attack in 2005 has shown that communication and information systems including private networks can be severely overloaded during major emergencies as a result of congestion, power failure, and system collapse (Alexander, 2005).

The utilisation of modern ICT technologies and platforms such as social media is emphasised as critical to ensure widespread communication and information access (Stal, 2013; Collins et al., 2016). Hazard and threat information is critical to the development of crisis plans at the local level that can ensure that crisis response processes and means are fully prepared and can be effectively mobilised (OECD, 2013). Information can also be usefully integrated to develop national plans and additional supportive capacities that can enhance response to large-scale crises (OECD, 2013). Communication and information sharing protocols can increase the flow and speed of information on a crisis event enabling actors and stakeholders to more rapidly organise. Daily monitoring and exchange of hazard information among critical services can additionally support early warning (OECD, 2013). Information derived from new technologies such as social media and crowd-sourced information to monitor social networks can provide early information before crises develop that can enhance crisis readiness and response times. Content communities can be monitored to identify emerging trends and possible crisis hotspots (Chan, 2013). During a crisis information gathered from social media postings frequently includes live images and geo-referenced updates which can be analysed to establish trends in road movements, the numbers of victims and people involved or even the level of public engagement in the crisis and communications (Collins et al., 2016). Data gathering by local communities supports assumption of ownership of the outcomes which in turn can support risk and crisis communication awareness and implementation (Stal, 2013). Risk mapping and geo-spatial tools can significantly enhance response times by rapidly identifying the locations of crises and providing data on the current state (OECD, 2013). One framework underlines the importance of communications systems that are computer-based and equipped with shared mapping systems (FEMA, 2001).

There is consensus in the literature on the importance of rapid and accurate information gathering and dissemination to relevant actors and the public (OCHA, 2016; Sokat et al., 2016). Information management activities are generally characterised by the gathering and use of different types of information across different phases of response (Sokat et al., 2016). Certain critical characteristics have been associated with the data to support a rapid response. Timeliness in collection, analysis and dissemination of data is a key aspect placing emphasis on both efficiency, minimal delay between collection and dissemination and maintaining data currency (OCHA, 2016). This links to a further attribute of the

frequency with which information is updated, by the minute, hour, day or other parameter (Sokat et al., 2016). Accuracy or reliability of the information is widely acknowledged to be essential (Galton and Worboys, 2011; OCHA, 2013) in addition to content that should provide vital knowledge on key aspects such as the infrastructure and resources supporting the crisis response efforts (Sokat et al., 2016). Critical content can include operational datasets, contact lists and associated role and functions data. Important information should be created and shared by coordinating organisations using easily accessible and simple media (Sokat et al., 2016).

The use of accurate knowledge within the planning process is identified as vital to effective crisis readiness planning (Quarantelli, 1998). This concerns both the risks and hazards that are or may be faced and how people deal with the crisis when it actually occurs. McLoughlin (1985) identifies the need to adopt hazard analyses and capability assessments which can also serve as a basis for scarce resource allocation.

Big data refers to the large amounts of information available in digital and social media regarding individuals, groups and organisations and their online activities. In the context of crisis response, mining and analysis of this information is increasingly viewed as valuable for addressing frequent information gaps and enhancing situational awareness during time-critical situations to support rapid and informed decision-making (Collins et al., 2016). Big data analytics enable real-time monitoring of road crises and the activities of emergency response teams and volunteers (Verma and Sehgal, 2016). The extent to which data gathering and analysis approaches utilise advanced computational and mathematical techniques that provide insights and awareness of the crisis is a key area for evaluation. Simulations and modelling based on big data analytics are being adopted to expand the predictive capabilities of planners to support decision-making and enhance crisis preparedness. Deep Neural Network (DNN) is one technique that can address the information and communication needs of crisis response organisations by identifying informative tweets and classifying them into relevant topics (Nguyen et al., 2016). Tools such as hazard maps allow for identification of road traffic crises with high probability of occurrence as well as likely traffic and accident crisis zones (Verma and Sehgal, 2016). Modelling techniques are increasingly utilising live crowd simulation data, video detection, algorithms, simulation experiments and different modelling methods such as

regression modelling to predict behaviour during crises. Agent-based modelling allows for the impacts of crises on critical infrastructure to be modelled and understood (Verma and Sehgal, 2016).

The integration of modern technologies in crisis communication are transforming how information is publicly disseminated in the course of crisis events. Social media in particular is widely acknowledged to be the most efficient and relevant means for delivering communications in modern crisis scenarios (Stal, 2013; Collins et al., 2016). The ready availability of social media platforms and tools such as discussion platforms and news aggregators enable organisations to comprehensively and efficiently disseminate, gather and analyse information (Stal, 2013). According to Chan (2013) social media fulfils four key functions in crisis management: information dissemination; information gathering; disaster planning and training; and collaborative problem solving and decision making.

Social media platforms such as Facebook and Twitter are widely regarded as critical sources of information for crisis response (Nguyen et al., 2016) and reflect principles of inclusiveness in relation to data gathering. Social mining describes a technique employed to search big data across social and digital media for specific information posted within a given time period (Collins et al., 2016). During crises people post updates on their status, request assistance, report infrastructure damage and provide other useful citizen-generated data (Vieweg et al., 2014). This can produce insights into what people within and external to the crisis are thinking, doing and communicating. Being able to accurately predict and identify how the public will and is responding to crisis events is considered a valuable capability that can help focus crisis communications and shape timely relief and assistance (Collins et al., 2016; Nguyen et al., 2016).

Table 4-2 Classification of Communications According to Global Best Practice

Classification of Communications Response	Very Important	Important	Routine	Does not require a response
Category	Rating 1 assigned to communication on emergency cases classified at risk to life or serious crime in progress	Rating 2 assigned to communication providing information that immediate emergency action is not necessary. May require provision of immediate units upon emergency. Damage not considered dangerous to persons or property	Rating 3 assigned to communication when the incident is not urgent but calls for a response (Non-immediate) to achieve high quality service to the caller's expectations.	Rating 4 is assigned to cases where the service required for the caller is sufficient through counseling. Necessary information provided or connected to other support bodies interested in providing the desired service
Response Time Targeted areas Internal	15 minutes	30 minutes	60 minutes	Does not require a response
Response Time Targeted areas External	30 minutes	60 minutes	60 minutes	Does not require a response

The classification of crisis communication response based on global practice provides a useful structure for evaluating speed and efficiency. Table 4-2 shows how crisis communications have been structured and classified accompanied by key metrics for evaluating performance in this area. According to WHO (2017) and FEMA (2001) this is designed to provide information to the public both prior to the crisis and throughout the emergency period using coordinated mechanisms and strategies.

4.2.5 Response Planning

Response planning is represented in all the crisis preparedness models reviewed and is associated with community preparedness, preparedness programmes and contingency planning (IASC, 2013). Directly linked to risk assessment, response planning has key importance for the optimisation of crisis response times mainly due to its role in ensuring that relevant stakeholders and actors possess sufficient resources and capacities including human resources, equipment and supplies to appropriately respond to crises (OECD, 2013).

Under this component FEMA and WHO frameworks define a number of processes:

- Collection, analysis and use of information
- Development, dissemination and maintenance of emergency management and action plans at local and national level
- Multi-hazard, multisectoral exercise management programme
- Inter-organisational collaboration and planning on intersectoral plans, resource-sharing agreements and mutual aid agreements (FEMA, 2001; WHO, 2017).

These processes reflect principles of collaboration and joint planning and multi-organisational partnerships. Organisational response planning centres on the adoption and development of formal crisis plans and coordination and mutual aid agreements (Sutton and Tierney, 2006). The literature draws attention to the role of qualified crisis readiness planners in coordinating crisis readiness programmes within organisations or more broadly (Alexander, 2005; Henstra, 2010).

While this aspect overlaps with other factors identified its distinctive aspect is in terms of the engagement of actors in the planning process. Focus is placed on establishing clear direction on the roles and responsibilities of different actors and operational response processes to streamline response times (OECD, 2013). A key challenge noted is the identification and involvement of both internal and external individuals or groups. Different actors should have familiarity with the planning although there may be variations in emphasis and content (Dynes et al., 1981). Sutton and Tierney (2006) classify response planning at a community and organisational level in which crisis plans can be either formal or informal. At the organisational level the literature on intra-organisational coordination and cooperation in crisis readiness emphasises the involvement of two critical groups of actors: senior level managers and politicians and the crisis readiness planner (McConnell and Drennan, 2006; Boin, 2010). The attitudes and acceptance of senior actors towards crisis readiness is viewed as critical to crisis readiness preparations which have been found to frequently lack economic and political saliency (Boin and Lagadec, 2000).

Emphasis is placed in the literature on a process of continual learning and improvement. Effective planning processes require that key personnel are involved in interpersonal knowledge sharing (Kartez and Lindell, 1987). A significant aspect of response planning

is the development of feedback mechanisms to incorporate lessons learned following a crisis or disaster that can support optimisation of response times.

4.2.6 Training

Training is recognised as one of the most pivotal factors in crisis readiness that can significantly contribute to lowering crisis response times. The primary goal is for training to equip crisis response public officials, emergency response personnel and other personnel units and individuals with knowledge of and familiarity with the detailed protocols and procedures of skills and knowledge to perform key tasks necessary for specific crises (FEMA, 2015). The literature provides consensus on the key elements and processes which are prioritised in existing disaster and crisis models to ensure the development of human resources for crisis response.

Firstly, comprehensive assessment, design and planning is established as the foundation and initial basis for developing capabilities of all personnel at all levels internally and externally in an inclusive approach integrating multi-stakeholders such as emergency volunteers (Dillon et al., 2009; Henstra, 2010; FEMA, 2015; WHO, 2017). In terms of training content, there is emphasis on several elements that should be embedded within training programmes. Attention is drawn to an all-hazards training approach that aims to address all types of crisis versus unique planning for each potential hazard. Research suggests that an all-hazards approach may be more effective (Perry and Lindell, 2003; Perry, 2007). These types of plans are acknowledged to have benefits in enabling overlaps and synergies to be coalesced, while single crisis plans may result in highly specified and non-applicable responses to crisis (Boin, 2010). According to Henstra (2010) a combination of approaches should be adopted focused on all-hazards planning while incorporating plans for the likeliest or most serious hazards.

The need for accreditation in training is driven by the overall importance of effective crisis preparedness and response and the requirement to strengthen core capabilities given increasing crisis risks and growing public expectations for efficient service delivery (EMAP, 2004). Accreditation ensures that crisis response personnel are trained in conformity with recognised national and international standards and benchmarks, safeguarding minimum requirements in training, administration, and service delivery (Fleming, 2010). Different crisis response services are associated with their own

accrediting agencies which define specific service-related standards for training content and professional development that generally incorporate both theoretical and practical skills development (Fleming, 2010).

Role-specific knowledge and skills at individual and organisational level to create capacity and enhance existing abilities are emphasised in the literature (Eriksson, 2015). Generic versus agent-specific planning is a further key factor in crisis readiness planning and learning. Certain generic tasks and operational functions are critical for responding to any crisis such as overall coordination, information gathering and sharing, communication and warning, evacuation and sheltering (McLoughlin, 1985; Boin, 2010).

Table 4-3 Core Competencies for EM Professionals

Core Category	**EM Competencies**
EM Competencies that Build Relationships	Disaster Risk Management
	Community Engagement
	Governance & Civics
	Leadership
EM Competencies that Build the Practitioner	Scientific Literacy
	Geographic Literacy
	Sociocultural Literacy
	Technological Literacy
	Systems Literacy
EM Competencies that Build the Individual	Operate within the EM Framework, Principles, & Body of Knowledge
	Possess Critical Thinking
	Abide by Professional Ethics
	Value Continual Learning

Source: Feldmann-Jensen et al., (2017, p.6).

Emphasis is also placed on specific national context training opportunities (IASC, 2013), with consensus in the literature that training can be delivered and developed in relation to specific competency frameworks and requirements for crisis response (FEMA, 2001; Feldmann-Jensen et al., 2017). The literature points to next generation core competencies for emergency management professionals that provide a structured framework for development of behavioural anchors and key actions for measurement (Feldmann-Jensen et al., 2017). Feldmann-Jensen et al., (2017) prescribed 13 different sets of competences grouped into three core categories to inform the development of emergency practitioners:

Learning of general principles versus specific details is considered important, as planning and plan documents may rapidly lose currency given the dynamic and changing nature of the external environment and crises themselves (Dynes et al., 1981). Feedback from training can be employed to improve response planning as it facilitates learning and development that can ensure effective response to a crisis situation (Dillon et al., 2009).

Pang and Marton (2005) stress that the quality of training can be impeded by subjectivity of individuals in understanding concepts and processes. This has implications for evaluating training programmes and addressing individual learning styles. Training components for crisis readiness should therefore emphasise opportunities for such thought processes combined with regular and consistent training programmes that ensure clarity and calm decision-making in the context of stressful crisis situations (Weick, 2010).

4.2.7 Exercises

Exercises are recognised as a major dimension of training and preparedness (FEMA, 2001; IASC, 2013). Exercises are settings in which knowledge of procedures and protocols can be practiced and rehearsed enabling crisis response to be rapid and highly organised (OECD, 2013). They enable organisations to validate an emergency plan involving rehearsing key personnel and/or testing systems and procedures for crisis response (Dillon et al. 2009). The scope can extend to functional and full-scale exercises to evaluate the capability of emergency management systems in an interactive manner over a period of time (FEMA, 2001; Drennan et al., 2014). According to Pearson et al., (1997) the most effective crisis response emerges from organisations where all levels of staff have had the opportunity to reflect on and consider crisis challenges beforehand.

Existing models stipulate regularly scheduled simulations, drills and practical exercises for local, national and/or international actors (FEMA, 2001; Sutton and Tierney, 2006; IASC, 2013). The principle of routineness is a major underpinning of exercises in order to establish a mindset that ensures familiarity and in-depth knowledge of how to respond to crises (Borodzicz and van Haperen, 2003). Learning or task routineness is the regular performance of training, simulations and operational procedures that can support emergency worker readiness for crisis events. Critically this is based on a repetitive

framework supported by standard operating procedures which define procedures, resources, roles and responsibilities (Cronin, 2015).

Exercises are associated with a number of positive outcomes that enhance crisis readiness. For instance, research shows that learning experiences positively enhance cognitive sense-making abilities (Lampel et al., 2009; Cronin, 2015). They can increase crisis responder familiarity with communication protocols and responsibilities in the event that communication systems are disrupted during an actual crisis (Gordon, 2002). Such training helps develop awareness and a knowledge base that emergency responders can draw upon in the event of a crisis, in turn reducing anxiety and stress in crisis situations amongst all levels of staff (Cronin, 2015). According to FEMA (2013) exercises can help identify strengths and weaknesses in crisis readiness programmes and clarify interagency roles and responsibilities in addition to enhancing performance during an actual crisis. This evidence provides theoretical support to utilise such outcomes as individual level performance indicators for measuring the effectiveness of exercise programmes.

At organisational level several benefits of exercises can also be utilised as a basis for performance measurement. Firstly, exercises can provide a source of data that can support planning in the absence of real-world crises (Acosta et al., 2009). This data can provide useful benchmarks of different organisational processes. It can provide indication of equipment and team functioning during exercises as well as measuring the level of trust and familiarity between actors and organisations (OECD, 2013). A key mechanism is evaluation reporting based on participant assessments and expert observers. This can promote identification of capabilities that require strengthening and contributes further to development and enhancement of crisis response strategies and structures (OECD, 2013).

4.2.8 Logistics and Facilities

Logistics and facilities planning are reflected in all models and are addressed in relation to contingency and standby arrangements for crises including stockpiling resources and contingency partnership resource and supply agreements (IASC, 2013). The majority of frameworks emphasise the development of logistics capabilities and mechanisms which fall into four key categories of material management, property management, facility management and transportation management (FEMA, 2001; Sutton and Tierney, 2006;

WHO, 2017). The WHO (2017) framework focuses on access and availability of crisis response stocks and equipment at community as well as at global level. Reflecting principles of collaboration and multi-organisational partnerships emphasis is placed on the development of alternative logistics mechanisms and facilities and external support in the event that existing logistics are damaged (FEMA, 2001; WHO, 2017).

4.2.9 Public Education and Information

Public education extends the notion of crisis readiness to the wider public reflecting an inclusive approach to preparing and responding to crises. Public education definitions emphasise a comprehensive process in which the public is informed and educated on crisis risks, the readiness activities that crisis response organisations have in place to provide support, as well as the measures the public can undertake to mitigate those risks (Alexander, 2002). Public education is considered in the majority of models that emphasise an effective public education programme on local or national hazards and risks to enhance community crisis preparedness (FEMA, 2001; Sutton and Tierney, 2006; WHO, 2017).

Pre-crisis public education is stated to centre on public awareness of the risks and the key steps needed to prevent those risks (Norman and Coles, 2003). Critical measures include accurate, timely and useful information provided to the public on what is or could occur, the hazards that could affect their region, the emergency response that can be expected, and what measures the public can take to stay safe (FEMA, 2001; Coppola, 2007). To ensure that such information reaches the population emphasis is placed by FEMA (2001) on the development of ties between public information operations and local and national media.

4.2.10 Legal and Institutional Frameworks

Ensuring that proper legal and institutional frameworks are in place that support crisis readiness and the development and maintenance of emergency management programmes is a key component in most models (FEMA, 2001; IASC, 2013; WHO, 2017). There are a number of recurring themes: crisis readiness legislation; policies and strategies that integrate emergency preparedness; national plans and disaster authorities; cross-sectoral and sectoral frameworks; resource allocation and funding mechanisms, and regional and international agreements (IASC, 2013; WHO, 2017).

Legal and institutional frameworks have some importance for crisis response times in terms of framing and underpinning mechanisms, structures and processes which activate, coordinate and scale up crisis response at different levels from local to national and beyond (WHO, 1999). Legal frameworks can enhance crisis responsivity by establishing authority for the initiation and implementation of crisis response ensuring that this is not impeded, as well as establishing processes to facilitate difficult decision-making in the face of uncertainty and unknown factors (OECD, 2013). This aspect emphasises the definition and clarification of emergency powers, authorities and responsibilities in the event of a crisis (FEMA, 2001) and is a reflection of the political commitment of national governments to ensuring effective crisis response.

Frameworks can further enforce a legal mandate to undertake appropriate training and capacity building that can positively impact response times. Their importance is underlined by the fact that they can enshrine targets and indicators for desired crisis response times that drive change processes towards improvement and optimisation (Capistrano and Singh, 2012; IASC, 2013; WHO, 2017). Incorporation of international standards may also be subject to legal mandate to ensure monitoring of compliance in line with international legal frameworks as well as use of technical assistance for implementing global and regional intergovernmental frameworks (WHO, 2017).

4.2.11 Hazard Management

Hazards represent a unit of analysis and point of focus to which all effort and resources for crisis readiness and response are directed toward. Hazards are defined as events, situations, processes or substances which are actual or potential sources of harm (NRC, 2006). According to the Food and Agriculture Organization of the United Nations (FAO), disasters are the occurrence of different types of hazards that have extreme impacts on societies and family in the short term or for many years (Baas et al., 2008). Disasters are consequences of a combination of hazard risk conditions, social vulnerability, and the limited capabilities of communities to minimise the prospective destructive influences of the hazard (UNISDR, 2017).

The management of hazards is a component of crisis readiness in two of the models, and is described as a systematic approach that involves three key elements of identification, assessment and mitigation of hazards posing significant threats by

eliminating them or reducing their effects (FEMA, 2001; Sutton and Tierney, 2006). The use of common crisis readiness functions that operate across all hazards boundaries is a key feature and includes functionalities such as: direction and control, warning and communication, continuity of government and operations, maintenance of essential public services, and resource management.

Vulnerability is a significant component in the risk context, and for this there has been growing interest in understanding the capabilities of the public to manage the effect of hazards. The identification and assessment of hazards links to the risk assessment process in crisis readiness in much of the literature (IASC, 2013; WHO, 2017). Nevertheless Sutton and Tierney (2006) identify specific core features designed to lead to future mitigative actions including the conduct of hazard, impact and vulnerability assessments and detailed understanding of the impacts on populations and facilities, structures, and infrastructure. Crisis readiness literature and practice evidence a growing emphasis on an all-hazards approach to hazard management that provides the basis for comprehensive hazard management programmes (FEMA, 1996; WHO, 2017). This approach is based on the recognition that although hazards may arise from diverse sources such as technological, natural and societal they can pose similar challenges for systems and infrastructures and involve common elements of crisis readiness (WHO, 2017).

Hazard mitigation is stated to comprise practices implemented before impact and which offer passive protection at the time of impact (NRC, 2006). The literature indicates two types of passive mitigation activities of process/non-structural mitigation and project/structural mitigation (Sutton and Tierney, 2006; Waugh, 2015). The former features activities that result in policies, practices and projects that mitigate hazards. This includes: efforts to conduct risk and vulnerability assessments; the education of decision-makers and building political will; facilitation of selection, design, funding and construction of projects; land-use planning and building codes to mitigate losses from hazards and designing buildings to enhance surveillance. In contrast structural mitigation activities comprise measures to avoid or reduce the damage occurring as a result of crisis events such as disaster-proofing buildings or elevating or relocating threatened buildings or structures (Waugh, 2015).

Each hazard is acknowledged to have unique features thus literature and guidelines frequently state the importance of the development of detailed hazard-specific plans to supplement all-hazards planning (FEMA, 1996; IAEM, 2000; WHO, 2017). FEMA (1996) specifies that hazard-specific aspects should be addressed within all-hazards rather than stand-alone plans. The involvement of all crisis readiness actors in partnership and cooperation is a further key feature (FEMA, 1996; WHO, 2017). There are implications from this approach for law enforcement in terms of cross-functional and cross-agency training, and the creation of specialised rapid response teams including in urban search and rescue and first responder anti-terrorism teams.

4.2.12 Early Warning

In the crisis readiness literature risk assessment and early warning are integrated components as risk assessment and environmental monitoring in terms of forecasting and preparing for risks. Early warning can have a significant impact on crisis response times by enabling precipitous and timely activation of crisis plans, teams and resources. In addition to ensuring a state of readiness prior to the onset of the crisis and a more rapid response when it occurs (UIC, 2017) it enables the public and organisations to trigger their own crisis plans and precautionary activities and begin undertaking their own roles in the response system to facilitate greater rapidity in response (OECD, 2013). Early warning features in most models related to the preparedness of alert systems at a local, national, regional and international level (IASC, 2013).

Early warning systems depend on mechanisms by which stakeholders and the public receive relevant and timely information in an understandable way prior to a crisis or disaster in order to make an informed decision and take action (FEMA, 2001; OECD, 2013; UIC, 2017). Early warning systems are evaluated in terms of the technological capability and functioning of early warning systems. In FEMA's (2001) model this is comprised of demonstration and testing of warning system capability such as the hardware and/or software to ensure appropriate operability. The WHO (2017) model identifies a key aspect in the ability of multi-hazard early warning systems to be able to reach communities and to ensure awareness of health warning and hazard warnings and community emergency evacuation centres.

Literature highlights the relevance of early warning and the priority that should be assigned towards ensuring that communication systems are well-equipped and organised (Brito, 2012). Effectively coordinated communication systems are noted to help to reduce confusion between crisis responders and the public, assisting them to discharge their responsibilities in addition to informing, advising and warning the public (Molino, 2006). In terms of early warning to responses, databases represent a critical component that provide information to responders to aid this process (Brito, 2012). This depends on the integration of real-time data from surveillance systems and community event-based surveillance that monitors and reports on potential crisis (IASC, 2013). The main goal of effective crisis planning is stated to be the identification of early warning signals for a crisis based on close observation of the environment (Paraskevas, 2006). Significant emphasis is given to the development of early warning systems that incorporate continuous vigilance and managerial sensitivity to risks (Shrivastava and Mitroff, 1987).

4.2.13 Recovery Initiation

The initiation of recovery is a key component in half of the models relating to both immediate and longer-term steps towards recovery (Sutton and Tierney, 2006; WHO, 2017). Emergency coping and restoration of key functions are noted to be immediate recovery priorities and require the development of adaptive capacities during crises of self-sustainability and improvisation (Sutton and Tierney, 2006). This has implications for crisis readiness planning and training as outlined by Sutton and Tierney (2006) who identify the importance of extensive "what if" explorations, diverse kinds of thought experiments, exercises in which crisis actors assume the roles of others, and discussions focused on potential worst cases.

Restoration of critical services and facilities such as utilities and transport are considered essential serving as a basis for early recovery activities and containing further impacts. Longer-term recovery processes are identified as key elements involving preparation of recovery plans at community, intersectoral, and national level and the development of ordinances and other legal measures to be activated following crises (WHO, 2017). Sutton and Tierney (2006) note the importance of advance planning for crisis recovery at household and community levels in terms of business continuity planning and financial crisis protection. Being prepared to initiate recovery following the

occurrence of a crisis is noted to help the speed of a comprehensive crisis response that ensures that key infrastructure and services are restored as rapidly as possible. Preparedness in this respect can ensure that key equipment, tools and supplies are readily available to launch recovery operations.

4.2.14 Operations and Procedures

Coordination and integration among different crisis responders is a key function that influences crisis response times and determines the speed with which agencies can activate core capabilities efficiently across all key stakeholders. The FEMA framework uniquely identifies operations and procedures as a standalone component within the crisis readiness framework (FEMA, 2001). It defines this as the development, coordination and implementation of operational policies, plans and procedures for crisis management. Effectiveness in this area is viewed as fundamental for regional crisis management structures to prepare, respond and recover from crises. The aim is to create and maintain a coordinated and integrated operational structure and process that effectively unifies all key stakeholders and enables the activation of core capabilities. This highlights principles of inclusiveness, collaboration and joint planning. Evaluations of operational readiness using the FEMA framework focus on a number of key attributes including the extent to which emergency management organisation is coordinated with national, local, and private emergency organisations and services. Operations and procedures should specify the co-ordination of services and supplies and have the ability to respond to different hazards (FEMA, 2001).

4.2.15 Property Protection

Property protection is identified by Sutton and Tierney (2006) in their systematic review as a key component. In terms of road traffic crisis responses, this might reflect the speed and effectiveness of agencies for expedient action to prevent loss or damage to property, facilities, buildings, equipment, secure critical records and ensure the maintenance of critical functions during crises (Sutton and Tierney, 2006). Crisis response readiness can be evaluated in terms of the utilisation of relevant construction standards and appropriate land-use practices in addition to capabilities for removal or retrofitting of structures at risk, installing and maintaining building protection systems such as fire and smoke alarms or emergency power generation systems, and facility

shutdown (Sutton and Tierney, 2006). Law enforcement assume a duty and responsibility to provide security to critical facilities, incident sites, damaged and undamaged public and private property and mass shelter and evacuation sites. Therefore the degree to which relevant agencies have precise and predefined tasks and objectives can be a significant measure of readiness (Phillips, 2016).

4.2.16 Crisis Leadership Development

The frameworks do not include crisis leadership development as a key component however all of the frameworks highlight the importance of leadership in ensuring preparedness and managing and coordinating an effective response to crises (FEMA, 2001; Sutton and Tierney, 2006; IASC, 2013; WHO, 2017). This places emphasis on the inclusion of leadership development as a component of crisis readiness. This is consistent with widespread acknowledgement in the literature that training for effective leadership during a crisis is necessary across all management levels and can contribute to eliminating or mitigating a crisis (Wooten and James, 2008). Limited research exists specifically in the context of leadership for crisis readiness however and research gaps are evident in terms of identifying the most appropriate leadership strategy to adopt for crisis events (Devitt and Borodzicz, 2008; Cronin, 2015).

Effective crisis leadership in the response phase of crises has been associated with a range of specific competencies and practices. Competency needs are identified based on the demands that crisis places on leadership (Van Wart and Kapucu, 2011). Firstly the need for calm but strong leadership is linked to competencies of communication, motivating subordinates, vision articulation, and willingness to assume responsibility. The necessity for pragmatic decision-making while operating under significant resource and time constraints is linked to decision-making and analytic skills, decisiveness, flexibility and willingness to delegate. Finally the need for coordination and reorganisation involves competencies of team building, operations planning, networking and partnering and social skills (Van Wart and Kapucu, 2011).

Some literature suggests that training in certain leadership styles may be more important than others for leading crisis events, specifically charismatic and transformational leadership. Charismatic leadership theory highlights important characteristics relevant to crisis leadership: it depends on crisis and instability to exist and

focuses on the significance and entirety of the current situation and conditions as well as traits and behaviour (Hackman and Johnson, 2009). Communication competencies are strongly associated with charismatic leadership and provide the foundation for influencing and inspiring subordinates and teams in a positive direction to achieve group goals (Cronin, 2015). These attributes are potentially crucial for leading in the uncertainty of a developing crisis within a highly emotive and pressured context.

Research also indicates that transformational leadership would be a critical area for crisis leadership training and development. DuBrin (2013) provides empirical evidence that transformational leadership is the most comprehensive leadership strategy for providing direction through a crisis. To an extent this relates to transformational leadership capacities during crisis events to deal with the environmental and psychological uncertainties faced by management (Hadley et al., 2011). Key components of transformational leadership have been identified as strongly supportive of crisis leadership: managing emotions effectively, developed self-awareness skills, bi-directional communication strategies, and the capacity to learn from a crisis (DuBrin, 2013). It has been argued that transformational leadership has value in a crisis in the ability to develop subordinate confidence and trust in leaders and develop psychological resilience and commitment to collective goals (DuBrin, 2013). In collectivist cultures transformational leaders are asserted to direct subordinates' sense of loyalty and obedience towards guiding organisations out of the crisis (Pillai, 2013).

The literature shows that training in crisis leadership may need to take into account the utilisation of a combination of different styles applied at different stages of crisis events and for different purposes. It has been argued for example that transformational leadership is the key applicable style in immediate crisis and post-crisis stages (DuBrin, 2013). Popper and Zakkai (1994) outline the conduciveness of transactional, transformational and charismatic leadership strategies to different situations. Charismatic leadership is identified as the most suitable for high anxiety crisis situations where there are conditions of change and crisis which intensify projection and transference processes. Transformational leadership is associated with less stressful situations where attention can be given to the organisational learning process within crisis events. For example Chatterjee and Pearson (2008) show that the ability to make situational assessments based

on past crisis experience and learned outcomes can ensure that leaders adopt a systematic and informed approach to decision-making. Assessment of crisis situations is also noted to emphasise information-sharing and the preparation of knowledge bases requiring a transformational leadership style that encourages knowledge sharing. Transactional leadership meanwhile is distinguished as the leadership pattern least effective for crisis situations (Popper and Zakkai, 1994). According to Cronin (2015) leadership strategies could be adopted concurrently during progressive phases of crisis events, so that charismatic leadership is used during the apex of crises and transformational leadership is considered throughout all crisis stages especially in the crisis readiness and post-crisis phases.

A number of leadership characteristics have been identified as important in crisis readiness. These include aspects such as obtaining sufficient resources for crisis readiness, adopting a comprehensive approach as well as acting as a bridge between organisation members and stakeholders (Grigg, 2003). In terms of staff, leaders need to be able to recruit and motivate a high-quality workforce, create buy-in and commitment, develop trust, and provide a guiding vision for change (Frederickson and LaPorte, 2002; Grigg, 2003). On a personal level leaders should actively engage in learning and be prepared to take risks (James and Wooten, 2005). Organisational learning is argued to emphasise the change and expansion of the organisational knowledge-base as a result of learning lessons from a crisis experience (Lampel et al., 2009; Madsen and Desai, 2010).

Crisis leadership development can be instrumental in enhancing rapid response times by developing the leadership capacities of the central actors with positive impacts on response efficiency. In addition to improving coordination and communication, leadership development can inspire and drive crisis teams and organisations towards higher performance. Such training at the strategic management layer tests leadership not on their knowledge of protocols or the actual protocols themselves but rather develops the capacity to adapt and innovate in a stressful, uncertain and pressured environment (OECD, 2013).

4.3 Performance Indicators

Performance indicators provide a vital platform for organisations to evaluate their performance and take the necessary steps in improving preparedness (Cardona and Carreno, 2011). This system allows the organisations and states to benchmark the evaluation of every state over time. It aids the steps taken towards a more analytical and data driven strategy to decision making on risk management. The approach helps in representing disaster at national level permitting recognition of critical issues relating to their characterisation from a socio-economic perspective and also assists in risk management performance benchmarking at national and organisational level in determining performance goals and objectives for improving performance.

One of the critical steps in index design criteria is the use of sensitive and accurate analysis. While its validity has not been evaluated in the current literature, some weaknesses of index design have concentrated on its lack of involvement and potential conflicting choices made in construction of the index. The possibility of missing validity and sensitivity and uncertainty examination is a key challenge when it comes to testing usefulness and meaningfulness of specific composite indicators and examining whether other more effective methods exist. Further research by Tate (2013) suggests that a range of these choices can consequently lead to changes in the results of the index. To fully assess disaster resilience, it is more accurate to use index and component indicators.

An index will give a summary of the state of disaster resilience and therefore provide a basis for denoting priorities for making changes in resilience to potential environmental hazards over time. The resilience method to managing adverse effects from natural disasters has been discovered most recently and suggests that people have the ability to prepare, adapt and change in presence of social integration and trust. Norris et al., (2008) suggest that disaster resilience originates from a set of four potential networks. From this, resilience is seen as a process rather an outcome and its potential is reflected in the changing capacities affecting society and population well-being. He further argues that economic development includes all the factors that support the level of economic resources available to the society including its quantity, diversity and how evenly distributed it is. Community competence includes the factors that allow people to interact and learn together and be in a position to adapt easily to changes including having

collective bargaining, problem solving and making sound decisions that would bring socio-economic benefits to the entire community.

Disaster resilience can be measured through quantitative or qualitative capacitive measures. UN (2014) conducted a pilot test to examine community resilience in Mississippi based on economic development and social capital adaptive capacities of Norris et al., (2008) which were proposed to be contradictory. Each assessment differed in various aspects. Dimensions of resilience also keep changing from time to time. Therefore design used in assessment should consider the scale used as temporary in the assessment relating to the purpose of the evaluation. Should the assessment at one given time be referred to as an audit, or be tested repeatedly to establish the pattern in resilience in relation to the basic condition, the temporary domain within which an evaluation is made should be noted to ensure that the resilience is not interpreted wrongly outside their temporal restricted zones.

It is thus important for organisations to provide structures, procedures, resources and time to enhance and increase training activities as well as encouraging performance techniques in responding to a disaster or crisis. It is also very important to realise that such activities as training and evaluations can increase knowledge about science for responsive performance, learning and gaining competence. In UAE, to increase disaster risk understanding and disaster risk management performance a comprehensive, transparent system of indicators should be in place. This system must be representative and easily understood by community and authorities as well as easy to update periodically.

4.4 Conceptual Framework

The different factors affirmed in the literature can be combined to provide a comprehensive conceptualisation of crisis readiness. The conceptual framework advanced in Figure 4-1 shows that crisis readiness is founded on a wide range of interconnected critical factors identified in the literature. The notion of crisis readiness is underpinned by multiple distinct but interrelated factors. Sixteen dimensions have been identified which are integrated into a comprehensive conceptual framework that guides the development of a crisis readiness framework. These elements have been drawn from

models and frameworks from different contexts and sectors. Crisis readiness of organisations can be evaluated in terms of the extent to which the essential characteristics of these elements are represented.

Figure 4-1 Crisis Readiness Criteria

The research challenge lies in employing this framework to explore the role of these dimensions within the specific context of road traffic crisis and the optimisation of crisis response times. The presented framework in Figure 4-1 guides the research design and focus and addresses the goal of this study. The application of these concepts provide the basis for exploring crisis readiness in the context of law enforcement and development of a strategic framework to identify and validate the key factors, approaches, priorities and measures to address the specific needs of law enforcement. This represents novel research into the specific context of road traffic agencies whereby each factor can be assessed and

prioritised. Table 4-4 provides a taxonomy of crisis readiness where each factor is associated with a number of critical elements identified across multiple studies or frameworks in the literature. This conceptual framework therefore identifies the main attributes of the concept of crisis readiness and addresses a gap in the literature for an extensive and integrated model to support the development of strategic frameworks.

The UAE and Arabic countries are undergoing substantial change development and crises and there are significant research questions that can further knowledge and contribute new insights into crisis readiness for Arab cultures. Specifically, a review of the literature gives rise to a number of research questions that centre the focus of this study: What are the critical characteristics of the crisis readiness elements to law enforcement in the United Arab Emirates? How can law enforcement agencies evaluate and develop readiness to respond to crisis situations? How can crisis readiness be operationalised within the different key elements and what measures or indices can be applied to evaluate crisis readiness? This conceptual framework can be used to investigate the main elements that can influence the development of performance indicators for UAE agencies to effectively respond to disaster and crisis situations. The research design informed by this framework is therefore directed firstly towards validating the applicability of each of the dimensions to the specific context of readiness for road traffic crisis and reduction of response times. Secondly, the research is guided toward establishing and validating the critical processes and performance indicators that can be used to evaluate and ensure readiness of law enforcement agencies to successfully respond and contain road traffic crises.

Table 4-4 Conceptual Framework

Critical Dimensions	Key Elements	Source
Risk Assessment	Risk identification and evaluation	WHO (2017); IASC (2013)
	Risk communications	WHO (2017), CCA (2004); Alexander (2009)
	Risk forecasting	WHO (2017); Sutton and Tierney (2006); FEMA (2001)
	Scenario analysis	WHO (2017); Sutton and Tierney (2006); FEMA (2001); Ikeda (2010)
	Community participation	WHO (2017); CCA (2004); Nagasaka (2006); Ikeda (2010)
	Inter-agency collaboration	WHO (2017); Sutton and Tierney (2006); FEMA (2001)
	Risk management information system	Sinha (2006); Ikeda (2010); FEMA (2001)
Hazard Management	Hazard assessment	WHO (2017); IASC (2013); FEMA (2001); Sutton and Tierney (2006)
	Impact and vulnerability assessments	WHO (2017); IASC (2013); FEMA (2001); Sutton and Tierney (2006)
	Hazard mitigation	WHO (2017); IASC (2013); FEMA (2001); Sutton and Tierney (2006)
Early Warning	Surveillance and detection system	Cameron et al. (2012); Xiao et al. (2015); Huang and Xiao (2015); WHO (2017); IASC (2013); FEMA (2001); Sutton and Tierney (2006)
	Multi-hazard monitoring and warning service	FEMA (2001), OECD (2013), UIC (2017)
	Co-ordinated communications	UIC (2017), OECD (2013), IASC (2013)
	Demonstration and testing warning systems	FEMA (2001); Brito (2012)
	Data analysis	Imran et al. (2017); Collins et al. (2016); Nguyen et al. (2016); Stal (2013);
Legal and Institutional Frameworks	Policy and strategies	WHO (2017); IASC (2013); FEMA (2001)
	Emergencies powers and responsibilities	FEMA (2001);
	Resource allocation powers	WHO (2017); IASC (2013); FEMA (2001)
	Funding	WHO (2017); FEMA (2001); IASC (2013); Sutton and Tierney (2006)
	National and international integration	WHO (1999); FEMA (2001); OECD (2013); Capistrano and Singh (2012)

Critical Dimensions	Key Elements	Source
Resources	Financial availability	Frederickson and LaPorte (2002); HofferGittel et al. (2006); Kovoor-Misra (1995); WHO (2017); IASC (2013); Sutton and Tierney (2006); Light and Morgan (2008); EU (2018)
	Human resources availability	HofferGittel et al. (2006); Kovoor-Misra (1995); WHO (2017); Light and Morgan (2008); EU (2018)
	Technological infrastructure	Zemp (2010); Collins et al. (2016); Light and Morgan (2008)
Coordination	Organisational structure	WHO (2017); FEMA (2001); IASC (2013); Sutton and Tierney (2006)
	Decision-making process	Shrivastava and Mitroff (1987); Borges et al. (2011); WHO (2017); FEMA (2001); Grigg (2003); Hofmann (2007); IASC (2013); Perrow (2011)
	Interagency arrangements	WHO (1999); FEMA (2001); OECD (2013); Capistrano and Singh (2012)
	Stakeholder relationships	Abbasi et al. (2018); Grigg (2003); Sutton and Tierney (2006); WHO (2017); Pearson and Mitroff (1993); Boin (2010); McConnell and Drennan (2006)
	Co-ordination platform	
Information Management and Communication	Development of information management system	Collins et al (2016); Stal (2013); Verma and Sehgal (2016)
	Communication response	OECD (2013); Collins et al (2016); WHO (1999); FEMA (2001); IASC (2013);
	Information gathering and data analysis	Kartez and Lindell (1987); Boin (2010); McLoughlin (1985)
	Simulation and modelling	Collins et al (2016); Rome et al. (2016); Sutton and Tierney (2006); FEMA (2001), Boin (2010); Mileti (1999); IASC (2013);
	Public information and education	FEMA (2001); Sutton and Tierney (2006); WHO (2017); Alexander (2002); Norman and Coles (2003); Coppola (2007)
Leadership	Crisis leadership development	Van Wart and Kapucu (2011); Wooten and James (2008); Cronin (2015); Hackman and Johnson (2009); DuBrin (2013a); OECD (2013)

Critical Dimensions	Key Elements	Source
Response Planning	Response plan	IASC (2013); FEMA (2001), OECD (2013), UIC (2017); Sutton and Tierney (2006)
	Co-ordination and crisis plans	WHO (1999); FEMA (2001); OECD (2013)
	Data collection and analysis	Boin (2010); McLoughlin (1985)
	Communication	Stal (2013)
	Inter-organisational planning	WHO (1999); FEMA (2001); OECD (2013); Capistrano and Singh (2012)
Training	Training plan	FEMA (2015); Dillon et al. (2009); Perry (2007); Perry and Lindell (2003); Henstra (2010); Quarantelli (1998); Van Wart and Kapucu (2011)
	Competency and skills framework	Feldmann-Jensen et al (2017); Van Wart and Kapucu (2011)
	Training evaluation	WHO (2017); FEMA (2015)
	Accreditation	WHO (2017); FEMA (2015); Sutton and Tierney (2006); IASC (2013); Fleming (2010)
	Content	Eriksson, 2015; Boin, 2010; McLoughlin, 1985; Miller et al. (2010)
Exercises	Drills and simulations programmes	WHO (2017); FEMA (2015); Sutton and Tierney (2006); IASC (2013)
Logistics and Facilities	Logistics plans	IASC (2013); WHO (2017); FEMA (2001);
	Access and availability	WHO (2017); Sheu (2007); FEMA (2015)
	Facilities	WHO (2017); Sheu (2007); Sutton and Tierney (2006)
Operations and Procedures	Operational policy	FEMA (2001)
	Operational plans	FEMA (2001)
	Incident Management System	Perry (2007); WHO (2017); FEMA (2015); Sutton and Tierney (2006); IASC (2013)
Public Education and Information	Pre-crisis education and awareness	WHO (2017); FEMA (2015); Sutton and Tierney (2006); IASC (2013)
	Public and social media communications	Collins et al. (2016); Nguyen et al (2018); UN (2015)
Property Protection	Containment	Sutton and Tierney (2006); Phillips et al. (2016)
Recovery Initiation	Restoration facilities and services	WHO (2017); Sutton and Tierney (2006);

4.5 Conclusion

This chapter has presented a review of the literature in the field of crisis management and crisis readiness. A review of the key models and frameworks of crisis preparedness and readiness provided a synthesis of the key concepts of crisis readiness to establish a comprehensive understanding of the important elements and principles identified in the literature. An extensive range of crisis readiness principles and components were identified that have been integrated to inform a conceptual framework to guide the research. A discussion was provided of the key attributes and significance of each of the crisis readiness elements to provide a theoretical foundation for field research and development and validation of a strategic framework that can support crisis readiness in law enforcement. To address the goal of this research, the framework and research questions developed will guide the research approach and inform the methodological design for this research in the next chapter.

CHAPTER 5: RESEARCH METHODOLOGY

5.1 Introduction

Research methodology is defined as *"the way in which one makes sense of the object of enquiry"* (Sarantakos 1998, p.465) and represents the plan and structure of investigation to address the research questions. The purpose of this chapter is to discuss the research methodology adopted at all levels of the research process that is focused on the development of a strategic framework for improvement of crisis readiness of law enforcement agencies in the UAE. The knowledge generated is specifically focused on the development of key performance indicators for establishing benchmark and development measures to enhance response times by Police for road traffic crises in the UAE.

This chapter provides a clear explanation and rationale for each aspect of the research methodology for this study in relation to the available options and methodological procedures that have been employed. The research process can be explained by the Research Onion model presented by Saunders et al., (2016) which provides a comprehensive overview of research in terms of connected layers that are critical for a rational and proper research approach.

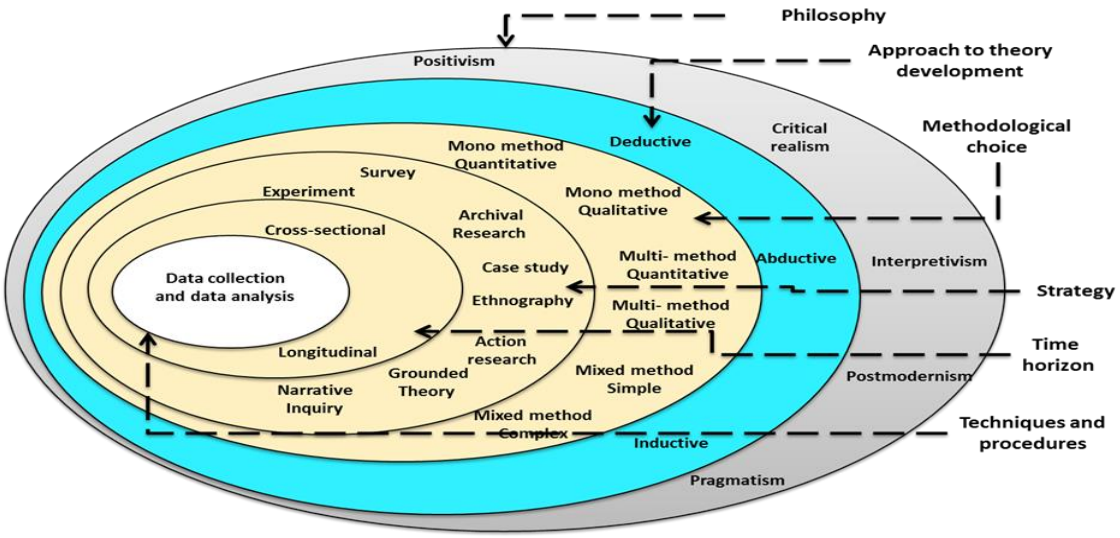

Figure 5-1 The Research Onion Model

Source: Saunders et al., (2016, p.15).

These layers represent the structure of discussion of the research methodology applied in this study. This commences with a discussion of the available research philosophies outlining the underpinning assumptions, implications and relative merits of these perspectives, and the influence on the research design and choice of methodological procedures. The position adopted for this study is then justified in terms of its appropriateness and usefulness to achieve the central research objectives. The research approach adopted forms the basis for discussion and justification of research design in terms of the nature of the inquiry that has been chosen. The rationale is presented for a pragmatist mixed-method approach that integrates both quantitative and qualitative data. Finally, this chapter describes and justifies the specific research methods relative to the range of options and suitability in addressing the research objectives. The subsequent sections address the methodological procedures for the data collection and analysis and ethical issues.

5.2 Research Philosophy

Research philosophy assumes a significant role in guiding the research design and methods adopted to address the goals of the research and create valid knowledge (Saunders et al., 2016). Research can be undertaken from the standpoint of different philosophical perspectives based on assumptions and beliefs in relation to how valid knowledge is created and how data on a phenomenon should be collected. The choice of approach is frequently based on two fundamental research alternatives of positivism and interpretivism (Saunders et al., 2016). Each of these philosophies differ in their assumptions in terms of the nature of reality (Saunders et al., 2016). The key assumptions underpinning each paradigm are outlined in Table 5-1.

Positivism is based on a scientific, empirical approach to research that asserts that observation and measurement are the foundations of social science research. This is based on the assumption of an objective and stable reality that exists external to human consciousness and can be explained through identification of causal laws (Bryman and Bell, 2007). This approach emphasises the experiment as the primary scientific method as it is argued that only measurable phenomena are the proper subject of scientific research (Eriksson and Kovalainen, 2008). While positivist approaches can vary the central assumption is that science is value-free and the main purpose of research is to

discover patterns and relationships between variables. While positivism is most closely associated with theory-testing and quantitative research, some qualitative research can relate to some positivist approaches (Eriksson and Kovalainen, 2008).

However positivist approaches have been criticised based on the argument that they oversimplify complex situations and the extent to which they can be reduced to their simplest elements (Creswell, 2009). This calls into question whether for this study a positivist approach would be sufficient to understand the totality of the problem. A focus solely on a quantitative approach may not generate the detailed, in-depth data that can support a richer explanation of the research phenomena (Saunders et al., 2016). In particular a deeper understanding of the reasons and motives for identification of key dimensions and factors for crisis readiness may be restricted by the use of solely quantitative methods. The implication is that a holistic comprehension of crisis readiness to inform a strategic readiness framework may not be achievable if the perspectives of social actors involved in strategic and operational aspects of the crisis readiness system are not captured and explored.

Table 5-1 Assumptions of Two Main Philosophies

Philosophical Assumption	Positivism	Interpretivism
Ontological assumption (The nature of reality)	Reality is singular, objective and is separate from the research	Reality is subjective and multiple as observed by the participants
Epistemological assumption How knowledge (reality) is obtained and accepted by the researchers.	The researcher is independent of what is researched.	Researchers interrelate with that being researched
Axiological assumption (the role of values)	Research is value-free and unbiased	Researcher acknowledges that research is value laden and biases are present that should be mentioned by the researchers.

Source: Adapted from Collis and Hussey (2014) and Creswell (2013)

In contrast an interpretivist perspective is founded on the central assumption that reality is comprised of the continuous and ongoing practices and actions of human beings as social actors. The belief is that knowledge of reality can be gained only from the

subjective interpretations of human beings within their context (Saunders et al., 2016). Individuals generate their own meaning in terms of a specific phenomenon with the result that multiple realities are created all of which are considered equally valid (Bryman and Bell, 2007). Under this perspective researchers are accepted as subjective interpreters of that meaning and an essential part of the research context (Collis and Hussey, 2013). Adopting an interpretivist approach would imply a subjective investigation considered applicable to examination of complex social phenomena, as it enables generation of rich and detailed data which could facilitate increased understanding of the underlying factors and influences that are not able to be measured with surveys or tests (Robson, 2002).

Applied to the topic of crisis readiness there is a rationale for providing a fuller understanding of the research phenomena by drawing on the perspectives of participants in this specific context. However while this may result in obtaining a more in-depth and holistic view of crisis readiness dimensions, reliance solely on this approach would undermine the ability to precisely and quantitatively determine the specific importance of different dimensions and factors of crisis readiness in relation to each other that can validate a crisis readiness framework for the UAE.

5.3 Discussion of Rationale for Research Philosophy

By contrasting the underpinning assumptions, philosophies and implications and relative merits of these philosophies, a rationale is presented to situate the research in a pragmatist mixed-method approach that integrates both quantitative and qualitative data. A pragmatist perspective recognises that *"there are many different ways of interpreting the world and undertaking research, that no single point of view can ever give the entire picture and that there may be multiple realities"* (Saunders et al., 2016, p.144). Pragmatism advances the notion that the research question is the key determinant for selection of research approach and both positivist and interpretivist approaches can be combined within the scope of a single research study according to the nature of the research question.

The rationale for the research approach is based on the focus and questions underpinning this research. The primary objective of this study is to identify the key strategic dimensions that can support planning to enhance response times of law

enforcement. A central assumption is that addressing this goal requires a primarily interpretivist approach in order to draw upon the multiple views of practitioners in the UAE. This emphasises on drawing on in-depth, rich perspectives of those in the field which can be contrasting and divergent. In turn this places stress on the qualitative nature of the research in order to generate a collective understanding and reconciling the different and subjective viewpoints of actors in order to isolate the key criteria and subcriteria that are critical to response times and can inform the formulation of a strategic framework. The interpretivist approach implies that research into crisis readiness is subjective and underpinned by human interest that creates in-depth and diverse insights to build a complete and holistic comprehension. The different factors of crisis readiness could be explored in a more detailed way by gathering the rich perspectives of different actors in the crisis readiness context. In spite of the appropriateness of the qualitative approach to achieving the research goals the requirement to ensure a scientific and structured approach for the decision-making and ranking of the criteria and factors, there is a need to consider a quantitative element. The assumption is that quantification can support the complex process of decision-making implied in this process by incorporating an objective evaluation process. The pragmatist research approach therefore integrates at the methodological level an objective evaluation process that utilises quantitative data to calculate consistency of the evaluation measures and alternatives and reduce bias.

This rationale is justified and supported within the literature where pragmatism is viewed as a practical and outcome-oriented approach that provides the philosophical freedom to select a mix of methods to most appropriately answer research problems that quantitative or qualitative approaches alone are unable to adequately address (Iaydjiev, 2013). The literature stresses the advantage of this perspective for understanding of empirical and practical consequences and the impact on study populations (Creswell, 2009; Teddlie and Tashakkori, 2011). In studies seeking to address real-world problems as in this case the findings from a pragmatist study may result in new initiatives, policy recommendations and organisational change (Salkind, 2010).

5.4 Research Approach

Inductive and deductive reasoning are two key approaches to achieving scientific knowledge. Deduction generates theories and hypotheses that are used as the basis for

describing and explaining specific phenomena (Eriksson and Kovalainen, 2008). The nature of this research can be considered and justified in terms of the differences between deductive and inductive approaches outlined in Table 5-2. Deductive approach is concerned with the exploration of causal relationships between concepts and variables. The main aim is to test established theories and assumptions by generating new data that can empirically confirm or modify them (Bryman and Bell, 2007). Therefore a deductive approach shifts from a general level to testing theory at a level which is more specific (Saunders et al., 2016). In contrast induction utilises observation about phenomena as the basis to infer general assertions applicable to similar cases. This approach is consistent with the nature of this study which is focused on an inductive case study to promote an understanding of the key factors and measures that contribute to improvement of crisis response times through the development of a strategic framework. The choice of a research subject and the overall research purpose depend upon and are influenced by concepts, theories and values (Holden and Lynch, 2004).

Table 5-2 Distinction between Deductive and Inductive Approaches

Deductive Approach	Inductive Approach
Testing theory	Building theory
Moving from theory to data	Moving from data to theory
Common with natural sciences	Common with social sciences
Scientific principles	Gaining an understanding of the meanings humans attach to events
Need to explain causal relationships among variables	A close understanding of the research context
Collection of quantitative data	Collection of qualitative data
Objectivism	Subjectivism
Operationalization of concepts to ensure clarity of definition	A more flexible structure to permit changes of research emphasis as research processes
Researcher is independent of what is being researched	Researcher is part of what is being researched
Necessity to select samples of sufficient size in order to generate a conclusion	Less concern with the need to generalise

The inductive approach of theory building begins with the coordinated perception of particular occurrences and attempts to set up speculations about the phenomenon under examination (Saunders et al., 2016). Rather than theory testing the inductive approach consistently emphasises theory building rather that moving from data to theory. The goal

is to generate deeper understanding of the meaning that humans have attached to situations rather than the application of scientific principles. Furthermore, this study aims to establish a close understanding of the specific research context of crisis readiness and response in law enforcement. This implies a reliance on qualitative data and subjective understanding. In this approach the researcher is part of what is being researched. In this study the researcher checks and validates the findings with participants through a process referred to as 'member checking'.

This involves the researcher presenting the information collected back to the participants, who are thus able to comment on and add to its interpretation (Saunders et al., 2016). The inductive nature of this study means there is less concern with generalisation and large samples and more focus on interpretation and understanding of the context.

5.5 Research Methodological Choice

Research design can be structured in terms of the methodological choice that determines the balance between quantitative and qualitative methods. There are several options that can be considered: mono method quantitative, mono method qualitative, multimethod quantitative and multimethod qualitative, and mixed methods (Saunders et al., 2016). In order to address the research goal of this study a mixed methods approach was viewed as most appropriate to draw on both qualitative and quantitative data. The research literature shows that the mixed method approach is valid and widely adopted where the research requires both types of data (Brewer and Hunter, 1989). In this study qualitative research is necessary to generate themes within the different crisis readiness, while a quantitative method enables the quantification of measurement of perceptions in relation to the importance of different components of the strategic framework under development. In addition this approach allows for a combination of data that potentially minimises the weaknesses and reinforces the strengths of any single data source (Brewer and Hunter, 1989). The outcomes of mixed methods research can therefore be of increased quality than studies relying on single methods. Quality is further reinforced as the use of mixed methods provides a measure of triangulation through allowing the combination of different data sources and methods to obtain a more accurate and nuanced understanding of the research phenomena (Saunders et al., 2016).

5.6 Research Strategy

Research strategy is a key element of the research methodology and provides an overall direction for the research including the process through which the research is conducted (Remenyi et al., 2003). A mixed method case study research strategy was selected for this investigation. Yin (2003) defines a case study as: *"an empirical enquiry that investigates contemporary phenomena within its real-life context especially when the boundaries between phenomenon and context are not clearly evident."* (p.13). The value of this strategy lies in the ability to investigate multiple situations in the particular to obtain rich in-depth insights and descriptions that can lead to theory development (Fearn-Banks, 2007). This approach is viewed as highly appropriate in developing a holistic and multifaceted understanding of the factors and key performance indicators that are relevant to improving response times of police to road traffic crisis situations. A single holistic case study design adopted where the context is the Ministry of the Interior in the UAE allows for the comprehension of the data important to examine the enhancement of the immediate response of the police sector during emergency and incidents in UAE. Figure 5-2 shows the single case study context focused on the specific context of the UAE Police and response times of police to road crises.

The different agencies reflect the research focus and represent the key sources of both qualitative and quantitative data for inductive generation of a strategic framework for improvement of police response time to road traffic crises. In relation to the research goal and practical time constraints the case study represents the most appropriate option in comparison with other alternatives. Commonly adopted research strategies used in social science research include case study, experiment, survey, grounded theory, ethnography, action research, cross sectional studies, longitudinal studies and participative enquiry (Collis and Hussey, 2014; Saunders et al., 2016). While quantitative-based strategies such as the survey strategy or experimental designs would have allowed large-scale analysis of and testing of variables, they would not address the exploratory requirements and need for rich in-depth inquiry to address the how and why of the research phenomena. In addition, a key strength of case study approaches is the ability to utilise a variety of methods to gather data and the integration of qualitative and quantitative methods (Yin, 2003; Saunders et al., 2016).

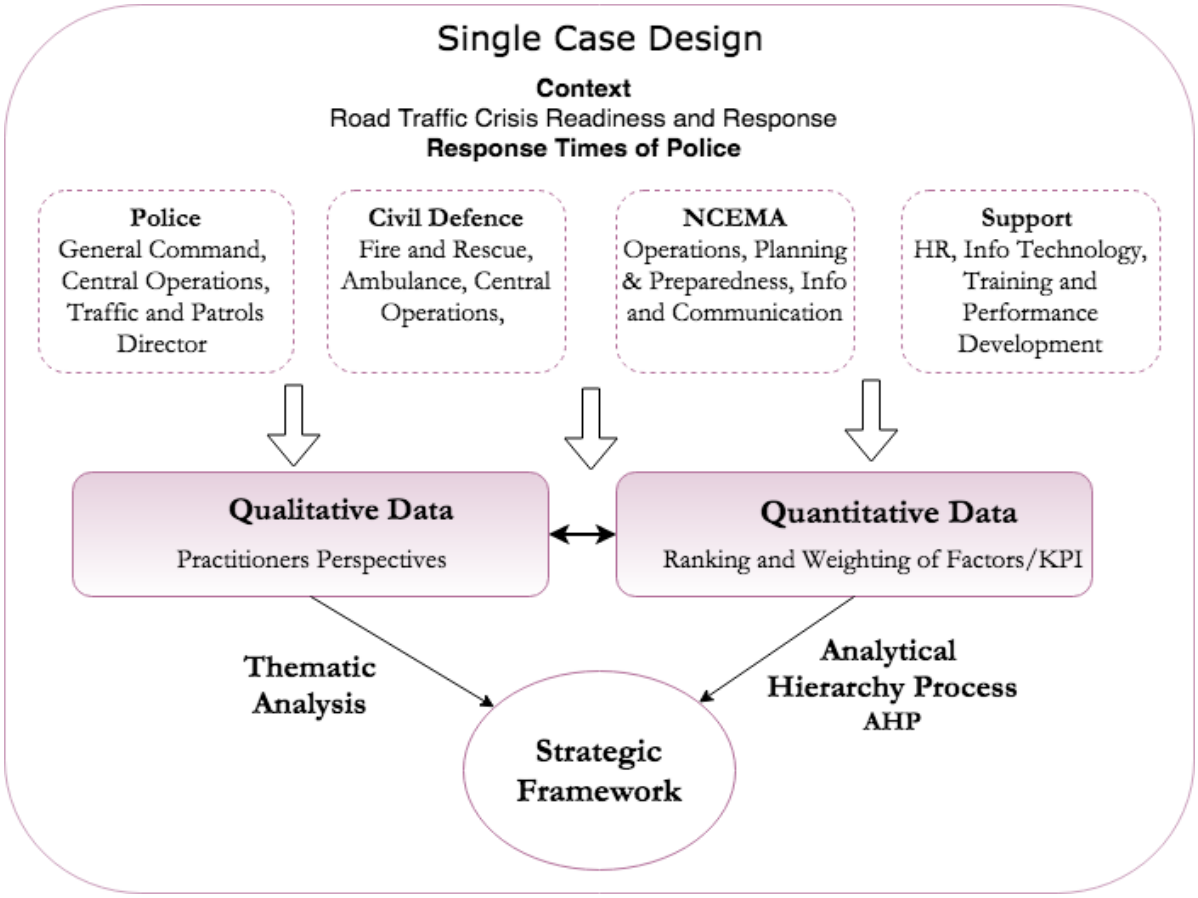

Figure 5-2 Case Study Design

This strategy is particularly justified because it enables the collection of qualitative data to explore the factors and performance indicators drawing on the views and judgements of key actors based on the real-life context. The quantitative component has been used to incorporate an objective evaluation process and empirical analysis to prioritise and weight the wide range of alternatives identified in the qualitative phase. In so doing the case study strategy provides the flexibility to sequentially gather multiple data sources. However a number of limitations can be acknowledged in relation to case study strategies in respect of a greater risk of bias on the behalf of the researcher and difficulties in generalising the results to wider populations and research contexts (Yin, 2003).

5.7 Research Methods

This research employs the Delphi Method as the primary data collection mechanism to gather qualitative and quantitative data. Questionnaire methods and the Analytical Hierarchy Process (AHP) are integrated into the Delphi method to complete the research

design. Table 5-3 provides an overview of the research and the relationship between these components. This section provides an explanation and rationale for the methodological choices adopted.

The Delphi method is a multistage process designed to attain convergence of opinion between a group of experts or experienced professionals on a specific real-world issue (Hsu and Sandford, 2010). It has been described as a problem solving process framework based on the results of several rounds of questionnaires distributed to a panel of experts. Experts' anonymous responses are aggregated and shared with each member of the panel after each round allowing experts to adjust their responses in later rounds according to their interpretation of the group response (Hasson and Keeney, 2011). The Delphi method has been widely used in research to identify, develop, validate and forecast in a diverse range of research areas including programme planning, resource utilisation, policy development and needs assessment (Hsu and Sandford, 2010).

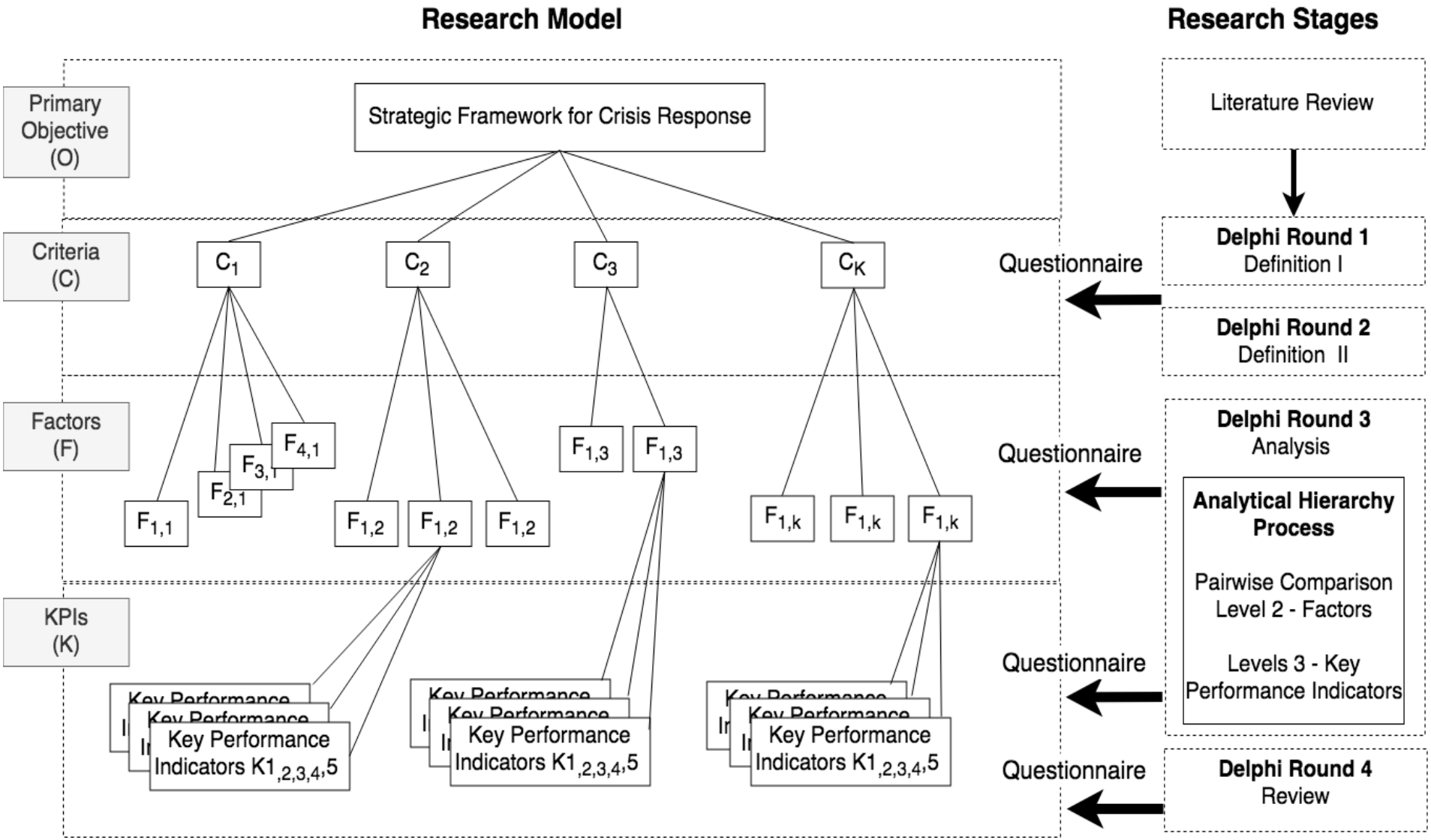

Figure 5-3 Overview of Research Design

Typically, three round Delphi's are performed however single and double round Delphi studies have also been conducted. The Delphi method can be applied in different ways depending on specific characteristics used. For the purpose of this research the Delphi is administered in accordance with Hasson et al., (2000) as group facilitation and an iterative process aimed at achieving consensus on the opinions of experts and key actors by means of a series of anonymously completed questionnaires. There are a number of established steps in a traditional Delphi study. The problem is first articulated, following which Delphi panel members are asked to provide their opinion by means of a series of questionnaires which are completed anonymously and independently. The results of the first questionnaire are analysed, transcribed and reproduced following which they are forwarded to each participant for review and a new round of questionnaires which is repeated three to four times after which consensus among the participants is usually achieved (Hsu and Sandford, 2010).

5.7.1 Discussion of the Rationale for the Delphi Method

There is a strong rationale for using the Delphi method in this study. Multiple methods are available for researching issues involving group communication to establish a consensus including a nominal group technique or brainstorming. In this respect the Delphi method has logistical advantages for this research which requires contacting people who are geographically dispersed to utilise their expertise in identifying the importance and criticality of sixteen key components of crisis readiness. An interview-based inquiry is less flexible in this respect and may result in the availability of a smaller pool of participants. This is because unlike brainstorming methods Delphi does not require real-time interaction allowing views to be gathered on these elements without the need to bring participants together in a physical location (Adler and Ziglio, 1996).

The ability of Delphi to provide both a reliable and creative means for exploring ideas further underpins the rationale (Adler and Ziglio, 1996). The method is acknowledged as a useful communication mechanism between a group of experts that systematically facilitates the communication of information and fosters the generation of a group judgement (Helmer, 1977). Delphi can be used to develop a comprehensive range of alternatives, uncover or explore underlying assumptions, in addition to correlating judgements on a particular topic across a broad range of disciplines (Hsu and Sandford, 2010). The effectiveness of the Delphi method rests on the use of experts, and the utilisation, combination and redistribution of their knowledge, which in turn enables new thought processes and ideas to emerge (McKillip, 1987).

Additionally, by using successive questionnaires opinions can be gathered incrementally in ways that do not promote adversarial processes and in which the current status of group collective opinion is consistently fed back to inform group members. This allows participants to consider and think through crisis readiness components and their constituents and consider the specific alternatives and measures that allow law enforcement to effectively perform their roles. Participants can then discern items or aspects that may initially have been missed or viewed as unimportant, thus providing them the opportunity to clarify, refine or change their views (Mckenna, 1994 as cited in Hasson et al., 2000; Adler and Ziglio, 1996).

5.7.2 Questionnaire Methods

During the Delphi process data was collected using online questionnaire methods where participants respond to the same set of questions in a predetermined order (DeVaus, 2002). The method is widely used to collect data across many different fields and disciplines in both research and practice (Saunders et al., 2016). As the responses are gathered in a standardised way a relatively efficient and objective means of data collection is afforded.

Questionnaires can be fully structured containing only closed-ended questions, semi-structured comprising both open-ended and closed-ended questions, or unstructured in which the majority or all of the questions are open-ended (Saunders et al., 2016). In this study all three types of questionnaire are used in different rounds to collect both qualitative and quantitative data for different relevant purposes.

In this research the open questionnaire was utilised to collect qualitative data on criteria, subcriteria and performance indicators participants considered important for enhancing road traffic response times. The design of this questionnaire is shown in Appendix C. Unstructured or open-ended questions do not suggest answers but rather allow participants to respond in their own words (Saunders et al., 2016). Their use in this study meant that participants had the freedom to generate their own responses that reflected their actual views and express what they judged to be important. This can produce more data that may be missed by the use of closed-ended questions and structured responses as respondents were able to include more information such as their attitudes, beliefs and perceptions on the topics (Bryman and Bell, 2007). As a result the reliability and validity of the findings are enhanced by providing a more authentic account (Saunders et al., 2016).

A semi-structured questionnaire was used to collect quantitative and qualitative data in round two of the Delphi. The employment of both closed-ended and open-ended questions allowed

for a quantitative judgement to be made on the key subcriteria and indicators while providing the opportunity for respondents to further explain or justify their assessment (Saunders et al., 2016). The inclusion of qualitative perspectives on judgements was considered important not only for the generation of a holistic and validated framework but also to provide the richness and detail that can be drawn upon to fully understand the how and why of each factor and indicator.

A structured questionnaire format was used to gather quantitative data and enable the analytical hierarchy process (AHP) process. Closed-ended questions allowed participants to submit objective assessment data by comparing the importance of criteria and assigning numerical values to their responses (Saunders et al., 2016). This enabled data to be gathered in a standardised and consistent way which enhanced the objectivity of the results while facilitating the comparison and analysis of responses.

5.7.3 Analytical Hierarchy Process

The Analytical Hierarchical Process (AHP) is integrated into the final phases of the Delphi process to provide a systematic and objective decision technique that supports development of the strategic framework. The Analytical Hierarchical Process (AHP) is a comprehensive framework that allows decision-makers to generate multi-objective, multi-factor and multicriteria decisions on any number of alternatives (Willyard and McClees, 1987). The approach is designed to enable decision-makers to incorporate objective and quantitative aspects as well as qualitative, more subjective facets of complex problems into effective decision-making. Complex problems are simplified and systematically resolved by breaking down the structure of a problem into hierarchies. Participants utilise evaluations of pairwise comparisons to decide the importance or preference in order to establish priorities within each hierarchy. The process has been applied to many different complex problems with a variety of decision analyses, allowing decision-makers to identify and determine ratio scale priorities or weights rather than assigning them arbitrarily (Richey and Grinnell, 2004). A hierarchy of decision elements is generated under a particular cluster after which comparisons are made between each possible pair in a cluster depicted as a matrix. This provides a weighting for each element within a cluster as well as a consistency ratio which facilitates assessment of the consistency of the data (Saaty, 1978).

The rationale for adopting this technique is validated by a wide range of literature that has applied AHP for the development of strategic frameworks across different domains:

environment, technology and business. Initially introduced by Saaty (1978), it has developed over the years to become one of the most widely used tools or mechanisms for multicriteria decision-making for decision-makers and researchers. Extensive literature based on AHP has been published in multiple and diverse fields (Phaal et al., 2001; Probert, 2003; Gerdsri and Kocaoglu, 2007). In terms of its relevance for this research context AHP has been widely applied to strategic planning and modelling processes and the development of strategic frameworks (Gerdsri and Kocaoglu, 2007; Sapkota, 2014). In the broad field of crisis management AHP has been found highly useful and applicable for decision-making in crisis and emergency management and strategic planning (Pourghasemi et al., 2012; Banihabib et al., 2015). Banihabib et al., (2015) used AHP to develop a strategic and sustainable planning framework to prevent Lake Urmia in Iran from drying up. In a study by De Felice et al., (2016) AHP was used to prioritise human factors in emergency conditions, enabling evaluation and identification of key priority actions to ensure human safety based on weighting and prioritising human errors and failure modes that characterise actions in emergency conditions. In the area of technology management multiple studies have investigated the use of AHP to evaluate or assess technologies in different contexts such as less developed countries, in research laboratories, for long-range planning, and to justify new manufacturing technologies (Ramanujam and Saaty, 1981; Suh et al., 1994; Albayrakoglu, 1996).

5.8 Data Collection Process

The Delphi method is conducted across multiple distinct phases. Table 5-3 presents the structure of the Delphi methods and the types of questionnaire and analysis employed in each stage of the process. Online questionnaires will be the main methods used to collect different types of data at each stage to address the research goals.

Table 5-3 Structure of Delphi Process

Delphi Method	Online Questionnaire Method	Data	Data Analysis
Delphi Round 1	Open-Ended Questionnaire	Qualitative	Thematic Analysis
Delphi Round 2	Semi-structured Questionnaire • Structured questions • Open ended	Qualitative-Quantitative	• Thematic Analysis • Descriptive Analysis
Delphi Round 3	AHP Pairwise Comparison Matrix	Quantitative	AHP Analysis
Delphi Round 4	Open-Ended Questionnaire	Qualitative	Thematic Analysis

The first round involves in-depth exploration of key components and their elements in which each expert provides additional pertinent information. Questions asked of participants can be both qualitative and quantitative in nature following which the opinions are analysed and summarised and provided back to each person. The next phase focuses on the process of attaining an understanding of how the group views the issue. Significant divergences in views are explored in further rounds to identify the underlying reasons for the differences and evaluate them. Subsequent rounds of questions elicit further responses which are then analysed and fed back to participants until over successive iterations the goal of consensus is reached that can offer both synthesis and clarity on the critical elements of crisis readiness for law enforcement agencies.

The process is completed when all the gathered information has been analysed and the resulting evaluations provided to participants for consideration. Summarised responses from each round of questionnaires are fed back to participants as a key element of this process. There is no direct interaction between experts which minimises the effects of social processes and influences that can contaminate the data in group contexts (Hasson et al., 2000). Critically, this mechanism provides an easy and convenient way for busy practitioners to participate in the process. The specific procedures for each round of the Delphi process are explained in the following sections.

5.8.1 Recruitment of Participants

To recruit participants key public sector organisations with responsibilities and involvement in road traffic crisis response were identified and relevant gatekeepers contacted. Key roles and responsibilities for personnel from a cross-section of stakeholder organisations were obtained from public and HR department sources. All participants were contacted by email and invited to participate using an invitation email with a link that provided access to project information and consent information, as shown in Appendix B. All communication and participation in the study was entirely by email. The initial contact informed them of the purpose of the study and nature of the research, how it was to be conducted and what participation would entail. Participants were then provided with opportunities to obtain more information on the study or clarify any questions or doubts they may have had. To mitigate any issues in relation to language barriers the research instruments and all research materials including participant forms were supplied in both Arabic and English.

5.8.2 Delphi Round 1 – Open Ended Questionnaire

The first round of the Delphi process involved the completion of an unstructured online questionnaire to obtain qualitative data from participants about what subcriteria and key performance indicators for each of the sixteen crisis readiness criteria they considered important for improving road traffic response times. Following their consent to participate participants were sent an email containing a restatement of the research goals, an outline of their rights as participants, and a form indicating their voluntary consent to participate. They were then provided with an online link to the questionnaire instrument that contained a list of open-ended questions that provided the opportunity for unstructured responses. The design of this questionnaire can be found in Appendix C. This initial phase formed the basis for the following stages by providing information on each criteria of crisis readiness that could be used to identify alternatives, priorities and preferences (Custer et al., 1999). Responses from the questionnaires were thematically analysed and the results used to develop the survey questionnaire for the second round.

5.8.3 Delphi Round 2 – Semi-Structured Questionnaire

In round two each Delphi participant was emailed a second semi-structured questionnaire which integrated all the subcriteria and measures generated from the first round. This allowed the opportunity for reflection on judgements and views and for the integration of new ideas. Participants were invited to review and rate each criterion as well as their associated subcriteria and measures summarised from the thematic analysis using a Likert rating scale to denote perceived importance. The semi-structured format provided opportunities for participants to provide a rationale and justification for the rating and priority given to specific items (Jacobs, 1996). This phase provided a basis for establishing preliminary priorities among items and forming early consensus on the importance of different elements at different levels of crisis readiness (Ludwig, 1994). At this stage those items with the least consensus could be eliminated to make the next rounds in which the AHP was applied more manageable.

5.8.4 Delphi Round 3 – AHP Matrix Questionnaire

In round three participants were invited to complete an Analytical Hierarchy Process form to derive the criteria, subcriteria and key performance indicators evaluated as most important for optimising road traffic response times. The AHP was conducted online over two phases in which Delphi members were asked to complete AHP questionnaires. The instructions provided to participants for completion of the AHP matrix are outlined in Appendix D. Participants were presented with a form for structured responses in which pairwise comparisons were arranged

in an empty matrix to derive priorities or weights for the items. This was then completed by comparing the items with each other and assigning a numerical rating according to their relative importance to the goal. For example participants may need to decide if Risk Assessment is more important, as important, or less important than Resources for response times and assign a value in relation to the extent of this comparative importance. Aligning with practice advocated in prior research (Saaty, 1980), the AHP questionnaire was designed using a 9-point scale to define pairwise comparisons, as shown in Table 5-4. For example if a panel participant considers that Coordination is strongly more important than Early Warning they will assign a rating of 5 and the latter will be rated as 1/5.

Table 5-4 Rating Scale

Strength of Importance	Definition	Explanation
1	Equal Importance	Two criteria contribute equally to the objective
3	Moderate Importance	Judgement slightly favouring one over another
5	Strong Importance	Judgement strongly favouring one over another
7	Very Strong Importance	A criterion is strongly favoured and its dominance is demonstrated in practice
9	Absolute Importance	Importance of one over another affirmed on the highest possible order
2,4,6,8	Intermediate Values	Used to represent compromise between the priorities outlined above

5.8.5 Delphi Round 4 – Review

The results from this round were then analysed and fed back to participants in the fourth and final round of the Delphi in which participants were presented with a final questionnaire containing open-ended questions on the proposed strategic framework for improving road traffic crisis response times. This provided a final opportunity to participants to revise and refine their judgements and finalise the strategic framework based on the research findings.

5.8.6 Pilot Study

Pilot testing of the different questionnaire instruments was conducted in order to optimise the reliability and validity of the data collection process and results. A pilot study can play a vital role in research and has been defined as a *"small study to test research protocols, data collection instruments, sample recruitment strategies, and other research techniques in preparation for a larger study"* (Lancaster et al., 2004, p.307). Conducting a pilot study helped to distinguish possible problem areas and deficiencies in the research protocols and instruments before implementation during the full study. It allowed the questionnaire to be refined and

modified based on feedback on the clarity of items and the ease with which the questionnaire can be completed (Check and Schutt, 2012). The questionnaire design for this study was tested among a small group of 5-8 public sector employees involved in crisis readiness who simulated the questionnaire process in a study environment. This enabled issues with the meaning and wording, structure and sequence of the questions to be identified in addition to how well the response categories were understood and the average length of time needed for completion (Check and Schutt, 2012). The results were used to refine the instrument so that the final design presented a smooth and logical structure, appealing appearance and clearly articulated questions that motivated participant completion and the validity and accuracy of responses (Check and Schutt, 2012).

5.9 Sampling Strategy

This research adopted a purposive sampling strategy, also referred to as judgmental or expert sampling (Lavrakas, 2008). This approach is a non-probability technique that selects participants on the basis of specific characteristics of a population and the study objective (Bryman and Bell, 2012). Purposeful sampling is widely employed in qualitative research to identify and select information-rich cases and individuals who are particularly knowledgeable or experienced with respect to the research phenomenon so that limited resources are most effectively used (Patton, 2002).

A total of sixteen participants were selected to be participants of the Delphi panel. The criteria for selection were aimed to ensure a diverse range of perspectives to build a panel of experts that represented variation in the number of organisations responsible for crisis readiness and diversity in terms of different roles and different levels of the organisation. Thus participants were drawn from a cross-section of public sector directorates and command authorities at federal and local level that have key roles and responsibilities for road traffic crisis readiness and response. As shown in Table 5-5 this included three representatives from the UAE Police, five participants from the National Emergency, Crisis and Disaster Management Authority (NCEMA), two participants from the Civil Defence General Command in addition to two participants from different Civil Defence operations directorates, one participant from the Ministry of Interior, one participant from the Federal Transport Authority, one participant from Abu Dhabi Department of Transport and one participant from the Dubai Road Traffic Authority. Further criteria were applied that ensured that participants were drawn from different levels of the organisation of management and operational. These actors can

provide varied insights and understanding of the essential elements to enhance police capabilities for crisis readiness based on their experience of responding to crises, managing hazards and recovery processes. To achieve the research goal emphasis was placed in the selection of all participants on the possession of lengthy tenure and extensive experience and

Table 5-5 Study Sample Characteristics

No	Organisation	Title/Position	Level	Experience	Age	Expertise	Qualifications
1	UAE Police	Officer	Chief Executive Officer	33years	51	internal security operations	confidential
2	UAE Police	Officer	Vice president	31years	50	internal security operations	confidential
3	UAE Police	Officer	Operational	29 years	49	Road traffic	confidential
4	NCEMA	Officer	Vice president	26 years	45	Crises management	confidential
5	NCEMA	Academic	Executive	31 years	51	Crises management	Prof
6	NCEMA	Officer	Operational	35 years	57	Traffic	confidential
7	NCEMA	Officer	Operational	40 years	60	Public Relations	confidential
8	NCEMA	Officer	Operational	20 years	39	IT	confidential
9	Civil Defence General Command	Officer	Vice president	27 years	44	Civil Defence	confidential
10	Civil Defence General Command	Officer	Tactical	29 years	43	Civil Defence	confidential
11	Civil Defence Operations Directorates	Officer	Operational	25 years	40	Civil Defence	confidential
12	Civil Defence Operations Directorates	Officer	Operational	30 years	49	IT	confidential
13	Ministry of Interior	Engineer	Operational	20 years	43	Traffic	confidential
14	Federal Transport Authority	Engineer	Tactical	30 years	52	Road traffic	Master
15	Abu Dhabi Department of Transport	Engineer	Operational	25 years	45	Road traffic	confidential

16	Dubai Road Traffic Authority	Engineer	Operational	29 years	50	Road traffic	confidential

skills in their fields (Linstone and Turoff, 2002).

Overall criteria were established to select individuals in each of the key agencies in crisis readiness that have comprehensive experience, knowledge and qualifications. Specifically people were selected based on the following criteria:

- Years of experience –individuals with the highest level of experience were selected with a minimum of 5-10+ years of experience reflecting cross-sectional areas of knowledge
- Experience in different roles specifically related to road crisis management and response
- Level of education and professional qualifications – individuals with comprehensive and up to date understanding of theory and principles of road traffic crisis management or related topics

The sample size of sixteen was based on time and resources factors and guidelines from the literature. Recommendations for the size of a Delphi panel range between 10 and 50 participants (Linstone and Turoff, 2002) and 15 and 60 participants (Hasson et al., 2000). The sample needs to be extensive enough to enable conclusions to be drawn, thus there should be a large enough number of answers for each question or statement. Okoli and Pawlowski (2004) suggest that a group between 9 and 18 participants is sufficient to draw relevant conclusions while avoiding difficulties in reaching a consensus among experts. The sample size for this study thus meets the minimum guidelines for a Delphi panel while achieving a size large enough to enable consensus to be reached and conclusions to be drawn.

5.10 Data Analysis

The qualitative and quantitative data arising from this research was subject to three types of analysis. Thematic analysis was used for the qualitative data collected from the first two rounds and the last round of the Delphi process. Descriptive statistics was applied to analyse data from the second round of the Delphi process. Data from the Analytical Hierarchy Process was subject to pairwise comparison analysis. The specific procedures are described in the following sections for each analysis.

5.10.1 Thematic Analysis

Thematic analysis is a widely adopted technique for identifying, analysing and reporting patterns in the data (Braun and Clarke, 2006). Patterns are distinguished and ascribed a theme or code and then iteratively regrouped into higher order classifications. Using this method provides a structured and systematic approach to analysing the data that contributes to the validity and reliability of the results (Saunders et al., 2016). A key advantage for this study was the flexibility and accessibility it afforded to address large sets of qualitative data while generating a detailed account of which factors are important for optimising road traffic crisis response times and why (Braun and Clarke, 2006). Themes can be inductively identified so that theme development is directed by the content of the data, or deductively developed so that coding and theme development are guided by existing concepts and ideas in theory and literature (Braun and Clarke, 2006).

The data from round one of the Delphi process was analysed to identify all of the subcriteria and key performance indicators that participants perceived were important for each criterion. The data from the open-ended questionnaire was firstly transcribed and then imported to Nvivo to allow for easier coding and analysis. Codes are words or small phrases assigned to symbolise or summarise relevant content or text passages to convey their essential meaning (Ryan and Bernard, 2003). Braun and Clarke (2006) recommend a six-phase, sequential coding process of: familiarisation with the data, coding, generating initial themes, reviewing themes, defining and naming themes and writing up.

The transcripts for this study were then read in-depth several times to obtain a level of familiarity with the data following which the first round of coding was applied. This involved identifying patterns in the entire dataset based on the themes emerging inductively from the data relevant to the research objective. Concise labels were generated that identified significant features of the dataset that may be relevant to addressing the research question. This phase involved coding the entire dataset and collating the codes and data extracts for later stages of analysis. This process was repeated several times during which certain codes were recombined or reconfigured and then applied to much of the same content. The codes and collated data were examined to identify important broader patterns of meaning and to generate initial themes. The final stage of coding refined and finalised the themes and subthemes to reflect the pattern of responses for the criteria (Ryan and Bernard, 2003). In this phase after checking the themes against the dataset to ensure they accurately reflected and addressed the research questions some themes were either combined, split into two or eliminated. Themes were named and

defined in terms of the scope and focus of each theme (Braun and Clarke, 2006). The results then formed the basis of investigation for the second round of the Delphi which aimed to quantitatively and qualitatively determine the relative importance of each factor and key performance indicator identified. The qualitative data from this round was similarly analysed to identify key themes in relation to the priority and importance assigned to each item.

The quantitative data from the second round was analysed to assess the level of consensus among participants on the relative importance of each item. In this study consensus was considered to have achieved a satisfactory level at 65% agreement as proposed by Graham and Milne (2003). This is consistent with overall guidance from the literature which shows that for Delphi acceptable levels range between a minimum of 51% to 80% agreement (Green et al., 1999). Following data analysis items that achieved less than 65% agreement were eliminated as non-essential while priority items were included in the AHP.

5.10.2 The Analytic Hierarchy Process (AHP)

AHP utilises mathematical techniques for processing the subjective and quantitative elements and preferences of the group making a decision (De Felice and Petrillo, 2014). The results on the comparative importance of the criteria, subcriteria and performance indicators from the Analytic Hierarchy Process (AHP) were analysed. This proceeded by firstly identifying the hierarchy of criteria, subcriteria and measures followed by judgments on pairs of elements to arrive at a dominant element for each one. This is expressed to obtain ratio scales used to select the most preferential or best perceived alternative (Saaty, 1990). Three distinct analytical phases are identified in relation to this process:

- Pairwise comparison and estimation of relative weights: For each element in each level comparisons are performed between any number of pairs in regard to their relative importance to the control criteria. Saaty (1978) proposes that comparison of two elements can be made using a scale of 1-9. Therefore a score of 9 reflects the high importance of one component over another while a score of 7 can reflect an intermediate importance. A score of 1 denotes the equal importance of both elements. These pairwise comparisons are able to be depicted in matrix form.
- Priority vector: Once the pairwise comparisons are completed, the priority weight vector (w) is acquired.
- Estimation of consistency index: As the numeric values are derived from the subjective judgements and preferences of participants inconsistencies are likely to occur. How

much inconsistency is acceptable is a critical issue that is resolved in AHP by calculating a consistency ratio (CR). This is obtained from comparing the consistency index of the matrix under analysis with the consistency index of a random-like matrix (RI) in which inconsistency is expected to be high (Mu and Pereyra-Rojas, 2017). Literature recommends that a CR of 0.10 or less is acceptable to continue with the AHP analysis (De Felice et al., 2016; Saaty et al., 2007). The consistency index (CI) of the matrix can be determined by CI = (λ max − n)/n − 1., where λ max is the largest eigenvalue of the judgment matrix A and n is the rank of the matrix.

5.11 Reliability and Validity

This study implemented a number of measures aimed to ensure the reliability and validity of the findings. Reliability is largely centred on ensuring the results are consistent to the extent that the application of similar data collection and analysis procedures will obtain similar results. On the other hand validity focuses on ensuring that the results actually describe what they purport to describe (Bryman and Bell, 2007). Undertaking measures to maximise the reliability and validity of the research instrument is a key element. When building the research instrument recommended design procedures were adopted which included piloting of the questionnaire and undertaking revisions based on the outcome (McNabb, 2010). Considerations of internal validity further need to be taken into account within instrument design to ensure that question items measure the proposed target and respondents understand all questions. In order to ensure this issue was addressed question items were used or adapted from established survey instruments where possible to enhance internal validity (Sudman and Bradburn, 1982) based on concepts and theory identified in the literature review.

External validity is regarded as the degree to which results may be generalised across different social settings. For qualitative research external validity is considered more problematic based on the characteristic reliance on cases and small study samples (LeCompte and Goetz, 1982). Rather scholars have identified trustworthiness, credibility and defensibility of the findings as more appropriate measures of validity (Patton, 2002; Stenbacka, 2001). In this study the trustworthiness and credibility of the findings have been maximised by the multimethod design adopted which enables cross-checking of the results obtained in a process of both method and data triangulation. Triangulation identifies the use of more than one method or data sources to examine the same phenomenon from different perspectives and approaches to substantiate and corroborate the research question (Bryman, and Bell, 2007). Patton (2002,

p.247) supports the use of triangulation by arguing that "*triangulation strengthens a study by combining methods. This can mean using several kinds of methods or data, including using both quantitative and qualitative approaches"*. Triangulation can reduce biases in the methodology design and the researcher and enhance the generalisability of the findings (Decrop, 2004). Two key types of triangulation have been employed in this research: data resource triangulation which enables different data sources to be utilised and gathered to achieve triangulation, and method triangulation which allows for the use of multiple different methods at different stages in the research to address the same research question (Patton, 2002).

A number of measures have been undertaken to ensure the reliability of the Delphi method adopted in this research. The composition of the Delphi panel has been suggested to impact the validity of the results (Spencer-Cooke, 1989). Delphi panellists are chosen primarily not for demographic representativeness but for the perceived expertise they can contribute to the topic under study and which can produce the desired valid results. Following suggestions by Scheele (1975) the panel was selected from stakeholders who are directly affected and have relevant expertise and experience in the field under study.

Moreover, the number of participants in a Delphi panel can impact the accuracy and validity of the results. Studies have found that error decreases with larger Delphi panels of eleven to twelve participants (Linstone and Turoff, 1975). Brockhoff's (1975) investigation of Delphi performance showed that panels with eleven participants had more predictive accuracy than even larger groups. Dalkey (1975) states that group responses under favourable conditions can be more accurate than those from any single member of the group.

Furthermore steps were undertaken to ensure that the anonymity of the Delphi panel was maintained even between members. This was considered important to enhance the validity and reliability of the results as anonymity allows consensus to occur among respondents without the undue influence of power, rank, or personality which can impact face-to-face group methods of data collection. Experts are likely to feel more free to give or change their opinion without the perception of losing face and without obvious biases such as gender or racial bias (Hiltz et al., 1989).

5.12 Ethical Considerations

This research has been conducted with understanding and consideration of the ethical issues and application of ethical principles of beneficence, fairness, autonomy, respect for privacy

and confidentiality. These principles have been considered throughout all stages of the research process from design to data collection and analysis and presentation of the results. Moreover, the research process was subject to ethical approval by the University of Salford Ethics Panel to provide external oversight and support to ensure that the research has been designed in an ethical way that safeguards the dignity, rights, safety and wellbeing of participants.

The protection of participants from harm and consideration of the needs and concerns has been of paramount importance. It is incumbent upon researchers to ensure that all precautions and measures of care are undertaken to safeguard participants (BSA, 2002). There is potential in any research to inflict harm in different ways: physical harm, harm to the development of a research subject, stress or loss of confidence (Crandall and Diener, 1978). The principle of beneficence imposes an obligation to ensure that any harm is minimised while maximising the benefits of the research (Belmont Report, 1979). The implications of each stage of the research were assessed and designed to ensure that all risks of harm would be minimised. Potential harm and discomfort from the interview process was mitigated by ensuring that procedures were clearly outlined and understandable and that participants were aware of issues associated with their involvement and happy with the interview process. In addition, the benefit of the research to society was maximised by ensuring a rigorous methodological design to ensure a reliable and valid contribution of knowledge. The principle of justice demands that the benefits and risks emerging from the research must be fairly distributed. Participants should receive a share of the benefits, in other words they should benefit from the knowledge acquired, as they have accepted the onus of participating (Belmont Report, 1979). There is high likelihood that participants would share in the benefits of this research due to the potential for the knowledge to assist in developing strategies for improving response times of police at road traffic crises and to save lives. Such knowledge from this study would be fairly distributed to all academics and practitioners in the UAE and beyond.

Furthermore, the research process was designed to ensure respect for the rights of participants in regard to autonomy and informed consent, privacy and confidentiality, and justice. A key responsibility for researchers is safeguarding participants' autonomy, and protecting participants from being taken advantage of in cases involving a loss of autonomy in the process of answering the research objectives. Informed consent is a critical procedure in achieving respect for individual autonomy in research (Belmont Report, 1979). To ensure informed consent information about the research was provided in an understandable form. Specifically, participants were able to make an informed decision based on a wide range of

relevant information including: aims of the study; what is involved; length of participation; benefits and risks; the right to withdraw at any point without prejudice; confidentiality procedures, and key contacts and sponsors (Belmont Report, 1979). This information ensured that participants were provided as much information as needed to make a conscious and informed decision on whether they wished to participate or not (Bryman and Bell, 2007).

Protection of privacy was respected by ensuring that participants were aware of their right to refuse to respond to any questions on subjects they deemed too sensitive to answer (Bryman and Bell, 2007). In terms of confidentiality, research data was designed so that no personal information of participants was collected, and all data was kept confidential (Saunders et al., 2016). Participants were made aware of the issue of confidentiality relating to the potential of some information identifying the organisation to be inferred from the published report. Importantly critical emphasis was placed on data protection which is a central issue in research ethics and enforced in legislation (EU, 2018). The failure to protect personal data against misuse or loss can have significant implications for the data subjects including potential legal, social, reputational or financial consequences (EU, 2018). This thesis undertook measures to ensure that the design of the research process and procedures complied with data protection legislation and were in alignment with established data protection principles. Firstly the data was securely stored using password and encryption techniques to avoid unauthorised access. A further measure involved the anonymisation of data so that it could not be identified with the individual participant to retain confidentiality. Finally the data will not be retained but destroyed when no longer needed. The right to data protection provides individuals with control over the way information about them is collected and used (EU, 2018). To fulfil this obligation research subjects were provided with full information on what will happen to the personal data collected.

Finally, measures were undertaken to mitigate the potential ethical issues related to language in this study. While the research is presented in English, the first language of the majority of participants is Arabic. This could mean that there may be language barriers among respondents that could exclude them from fully participating or place increased psychological stress through coping with the challenges (Belmont Report, 1979). To address this issue the research instruments and all research materials including participant forms were supplied in both Arabic and English.

5.13 Conclusion

The focus of this study is to investigate the concept of crisis readiness and develop a comprehensive framework that define and prioritised key dimensions and performance. This chapter presented the research and methodological considerations that guided the research process to realise the goal of this study. A key goal of this chapter was to demonstrate a systematic and well-planned research process that demonstrates the credibility and validity of the findings and conclusions of this study. The philosophical orientation of this study was situated in a pragmatic paradigm that attached importance to both positivist and interpretivist approaches. This has implications for a mixed method case study design that was comprehensively described in relation to the choices for research methods and all elements of the data collection and analysis, limitations of this study and consideration of ethical issues. In summary, this chapter described a comprehensive and systematic design that is most appropriate to the research goal and that facilitated the development and verification of the concept of crisis readiness for road traffic situations.

CHAPTER 6: CRISIS READINESS – QUALITATIVE RESULTS

6.1 Introduction

This chapter presents the results of the qualitative data collection process to address the research questions. Two sets of qualitative data were gathered of primary data from across two rounds of the Delphi process and secondary data collected from organisational documentation, guidelines and frameworks, reports and records. The results from secondary data analysis and each round of the Delphi are analysed, presented and structured in the three remaining sections of this chapter. The first round of the Delphi process involved the completion of an unstructured online questionnaire to obtain qualitative data from participants about subcriteria and key performance indicators as well as the barriers that impact on the role of law enforcement agencies within crisis and disaster management. Responses were thematically analysed and informed the second round. Following this, the results are presented for round two generated from the second semi-structured questionnaire which integrated all the subcriteria and measures generated from the first round. Quantitative analysis and thematic analysis of the qualitative data was conducted to determine the rationale and justification for the rating and priority given to key elements.

6.2 Existing Strategies and Practices

The first objective of this study was to evaluate road traffic crisis readiness and response strategies of the police in the UAE. A review of secondary data and qualitative interviews during the Delphi process identifies the key characteristics of crisis response in the UAE. There is recognition of and senior level commitment to increasing the ability of the police to respond in an increasingly integrated approach that addresses multiple dimensions and engages with a broad range of actors from across the crisis community. Firstly, organisational data and interviewee respondents indicated major focus on addressing a key performance indicator in terms of response times that is viewed as the primary measure and benchmark for evaluating the effectiveness of crisis response of the police. International comparisons showed that average response in the UAE was significantly lower than other countries. While there has been some improvement since 2016 the existing level of response is still significantly higher than global best practice. Broader evaluation of the crisis response components and processes has been recognised as critical to enhancing the responsiveness of police to road traffic crises. At national strategic level it is evident that the UAE has developed key strategies, objectives, planning, structures, roles and responsibilities at all levels of crisis response in the UAE.

The key strength of the existing framework is in the area of national disasters where the UAE has been highly proactive in building its capacity and defining key roles. The National Emergency, Crises and Disasters Management Authority (NCEMA) has mandated responsibility for multiple roles: oversight of national response capabilities and coordination of inter-agency co-ordination at state and local level. Crisis response strategies at all levels are framed around the National Response Framework (NRF) which defines crisis management standards based on key principles of: comprehensive approach; legal force; all hazards and scenarios; definition of roles and responsibilities. Notably, the UAE has developed its approach by integrating emergency management standards from international and national frameworks including the UK and Australia.

A second objective of this research is to identify the barriers that impact on the role of law enforcement agencies within traffic crisis situations. Analysis of the qualitative data and secondary data in respect of the UAE's existing approaches shows a number of performance issues and barriers become evident. Firstly, the secondary data pointed to a lack of integration at the federal level which can be characterised as highly decentralised by region and detached from the police force in other Emirates. Each Emirate has a dedicated regional crisis and disaster management team, headed by the high commander of the local police force, and technologies and systems. In respect of crisis management during disasters interviewees pointed to some overlap in relation to how prevention, preparedness and recovery efforts are coordinated with the police force which clearly assume a central role in leading responses and managing crises and disasters. Duplication of roles, communication gaps, and speed of response were identified as key issues. It was believed that greater optimisation in this area could positively influence the adoption of a more holistic approach to crisis readiness and response that links international, regional, national and local level initiatives to enhance preparedness.

At operational level interviewees underlined a number of performance issues in terms of interoperability, language barriers, resources, organisational culture and clandestineness and power. Documentation revealed a lack of standardisation and capabilities for knowledge sharing and communications across all control room processes. In terms of engagement the model in the UAE focuses on a narrow group of direct response organisations and partners and limited community or public collaboration. While the UAE has placed increasing priority on addressing crisis readiness and response overall the level of maturity of strategies and policies and procedures is low. Key areas of crisis readiness remain to be optimised and the framework

evidences gaps and underutilisation of key elements and dimensions that theory and practice shows are critical to crisis readiness. The remainder of this section presents the results in terms of the key barriers, challenges, gaps and issues impacting on the effective implementation of specific components of crisis readiness and response.

Analysis of primary and secondary data identified multiple gaps in current response planning practices in the UAE that undermine the ability to adopt a comprehensive approach to crisis readiness and response. Firstly, the secondary data shows that while the UAE has developed and documented standard operating procedures within the overarching structure of the National Response Framework that address responses to different types and sizes of emergencies, there is minimal definition of procedures that focus on response to extreme events and crises, and in particular limited evidence of scenario and contingency planning for major or unexpected crises and emergencies. Contingency planning is closely associated with risk management and addresses exceptional risks that, though less likely, may have disastrous consequences if they occur. Organisational evidence on recent instances of major road traffic incidents in the UAE points to a lack of contingency planning within the crisis response as evidenced by the scale of the incidents and the rapid escalation to higher levels of crisis caused by fire and other factors. Documentation of a similar incident in 2011 shows that some contingency planning had since occurred and measures such as police alert messages to the public and rapid activation of military support helped to avert some of the worst effects of previous crises. While this points to the existence of contingency planning for major road crises, the data shows that measures are focused predominantly on post-crisis response and there are few measures which address the crisis readiness and preparedness phase. Moreover interviewee data indicated that scenario and contingency planning continued to remain significantly underdeveloped within response planning processes. Few policies or procedures were in place to ensure that crisis response organisations undertook structured processes and methods of assessment and evaluation for different future risks and contingencies. One participant summarised:

> *"I think we still need to do much more scenario planning and considering the "what if" for unusual or unpredictable risks and events. Particularly we need to do more to prepare and plan for large scale disasters which until now we've never had in the UAE, which means our system has never really been tested at that scale".*

Another participant underlined:

"More scenario planning needs to take place coordinated with NCEMA and in collaboration with other agencies both national and Emirate level".

Interviewees further suggested that there was a lack of organisational skills and knowledge in relation to the ability to conduct effective scenario and contingency planning.

"In my department there aren't the personnel with the training or experience to accurately assess the level of risk or be able to plan for large-scale crises or totally unexpected emergencies. This is not something we do in coordination with NCEMA either".

Another interviewee suggested:

"While we are good at learning from past emergencies and planning for similar scenarios I think we at NCEMA need to develop broader planning capabilities that allow us to address unexpected emergencies in an efficient way so that our resources don't become completely overstretched".

The primary and secondary data revealed a further gap in that response planning processes were predominantly focused on post-crisis Response and Recovery phases and planning for pre-crisis preparedness was minimal. Organisational documentation showed that the National Response Framework is comprehensively applied to all stages of the emergency crisis management cycle. While much of the UAE's framework and guiding principles and strategies for crisis readiness have been adopted from international best practice and models the lack of a specific framework for crisis preparedness diverges in this regard. Frequently separate frameworks or planning approaches for each element of the cycle of mitigation, preparedness, response and recovery are formulated to address varying needs. Moreover the crisis management standards in countries such as the US incorporate all the frameworks within the preparedness phase. More specifically examination of organisational policies and data shows that a preparedness framework, cycle, model or procedure that guides the planning process has yet to be developed within the UAE framework and national response plan. Many of the key elements of preparedness frameworks have yet to be adopted. The primary reasons for this appear to relate to organisational and cultural factors. Data from interviewees identified a significant absence of clearly defined policies and processes and regulations for the development and implementation of elements of preparedness:

"Within the national response system we are aware there is a need for much greater definition and detail on strategies, policies and procedures to ensure there is an adequate

level of emergency preparedness. We know there are gaps in key aspects of preparedness that could be addressed by ensuring that planning processes consider all elements and we define preparedness activities and approaches in policies and legislation".

Another interviewee stressed:

"there is very little guidance from NCEMA to help to determine priorities for crisis preparedness or what we should be focusing on. We try to apply the framework but this is not detailed enough in relation to preparedness activities".

A lack of policies and processes related to building preparedness had several impacts in terms of undermining the inclusion of preparedness elements in planning processes, hindering the establishment of a standard for emergency preparedness activities and identification of roles and responsibilities of relevant crisis actors in preparedness. According to one interviewee:

"Improvements could be made to better define what constitutes effective preparedness and the actions that need to be taken in the preparedness phase by all agencies. Embedding preparedness within policies and action plans will enhance our operational readiness to respond".

According to another interviewee:

"I am aware that there is some confusion at different levels and in different agencies about what they are responsible for in terms of emergency preparedness".

In addition this reactive focus on response stages was associated with a low level of preparation for natural hazards that paid less attention to the promotion of awareness among the UAE population.

"I think we have tended to neglect the pre-crisis stages to focus on how effective we can be in responding to emergencies and crises. As a result there hasn't been a strategic emphasis on educating and making the public aware about potential threats and major hazards and I think this has had a detrimental effect on public preparedness".

Interviewees identified another barrier to effective response planning in terms of an overall lack of cooperation and engagement among crisis response agencies, and with other stakeholders such as non-governmental organisations and the public:

"There is significant scope for greater collaboration between agencies when it comes to response planning and setting priorities for emergency preparedness activities".

Primarily this reduced the effectiveness of response plans and their impact on crisis readiness as apart from central actors there was only minimal awareness of plans and necessary actions to be taken in the event of a crisis among wider stakeholders.

Another participant noted:

"From my position I can see that there needs to be broader engagement with different groups of stakeholders especially among the public. We need to do more to ensure that the public is represented in planning processes which in turn I believe would enhance the value and efficacy of response plans".

From the perspective of interviewees minimal cooperation between agencies had impacts not only on the ability to plan effectively for more common, smaller-scale emergencies but also larger-scale crisis events by constraining capacity to initiate effective contingency planning processes and develop contingency plans. Broader input from a wider range of actors and stakeholders was perceived necessary.

The qualitative data also pointed to a gap in terms of the development of plans focused on specific hazards or risks. While the National Response Framework does specify the development of response plans for specific risks identified in the National Risks and Threats Register, the framework provides minimal guidance and direction on how this should be accomplished. Interviewees identified a significant absence of planning processes that address specific risks based on different risk profiles at different levels of local or federal.

In terms of resources a number of issues were indicated that challenged adequate provision of resources for effective crisis readiness and response. There was consensus among interviewees for the need to increase and optimise human resources to address a shortage of specialised staff with specific roles. A lack of expertise was consistently identified in several areas including risk assessment and management that interviewees emphasised needed to be mitigated through training and recruitment practices. One emergency manager noted:

"A major barrier to effective crisis response is a lack of skills and capabilities in specific areas that needs increased dedicated, specialised human resources. I'm thinking in

particular of areas and roles such as response planning and risk analysis where we need increased development to ensure greater standards of planning and preparedness".

Another challenge related to an absence of established policies and procedures for the provision of resources for crisis readiness and response. In particular analysis of the data identified that there are no published procedures defining the responsibilities of different crisis readiness actors, agencies or authorities to provide resources and equipment. Moreover there is no central or dedicated actor or body that had responsibility for managing or controlling resources for crisis readiness. According to interviewees this impeded coordination of resources between local and federal level and meant that agencies relied on a spectrum of agreements between organisations and with the private and voluntary sector for the ad-hoc supply of needed equipment and resources during a crisis or disaster.

The results identified the existence of several issues and barriers that impacted the effectiveness of the training component to enhance the levels of crisis readiness within the UAE. A major issue highlighted by the interviewee data was insufficient training for many crisis readiness actors and stakeholders at different levels and in different roles either for the purpose of crisis readiness or for crisis management as a whole. According to a senior participant:

"We have good training provision and run plenty of exercises for crisis response activities, however I think where we have a major gap is in training and developing skills across all emergency managers in preparedness and planning".

Another participant expressed the view that:

"There are regional variations in training provision which means that not all people with similar roles get the same level of training. I am also aware that certain roles might have more specific training needs which currently are not being met".

This included a lack of strategic development of training programmes for crisis response and emergency managers as well as non-governmental organisations and community stakeholders and representatives. In particular specialised training on the concepts and principles of crisis readiness and emergency preparedness was virtually non-existent for the police, other crisis responders and broader crisis actors. Interviewees noted that this led to a lack of understanding within crisis response agencies in relation to the key principles and elements of crisis readiness. Training policies were further undermined by a lack of understanding in relation to the training

needed to implement crisis readiness standards and policies and ensure effectiveness in all elements and components of the UAE's framework for crisis readiness and response. Several participants summarised this:

"A big challenge is understanding how to align the design of training programmes with different policies and requirements for emergency preparedness, and to adapt to frequent changes in needs and demands".

"We do not as yet have a comprehensive training programme in place that covers all aspects of emergency preparedness and response for the relevant organisations and roles".

Challenges were also identified linked to more traditional, rigid approaches and attitudes towards training in the UAE. Interviewees indicated that there was an orientation in crisis readiness training programmes on a core, static curriculum, classroom-based approaches and text-based learning materials. Some data pointed to the belief that training programmes were not keeping pace with rapidly changing training needs associated with the dynamic crisis management context. Emerging new threats and risks and the consistent introduction of new technologies, equipment, methods and processes underlined the requirement for optimisation of training programmes and greater flexibility in training methods and content to address different conditions. Interviewees indicated that when new training needs emerged and were addressed this was frequently in an ad-hoc, unplanned manner that was not based on systematic processes of needs assessment. This was linked by interviewees to a lack of defined policies and procedures overall for coordinating and implementing training within the UAE framework.

The results from both the primary and secondary qualitative data showed that a number of issues and challenges impacted the effectiveness of the coordination element in the UAE's crisis response framework. Interviewees identified that coordination for crisis readiness is hampered by a lack of clearly defined policies and regulations that identify standards for crisis readiness activities and measures to promote cooperation and coordination between crisis response organisations. In particular the data revealed an absence of appropriate policies and mechanisms that facilitated and integrated coordination and minimal understanding of how coordination can be optimised. One senior interviewee stressed:

"Beyond basic stipulations in documents such as the National Framework there are few established processes or procedures that I'm aware of that define or provide guidance on

what we should be doing to coordinate with other agencies. While coordination of course does occur the mechanisms by which this happens have tended to develop organically and in an ad-hoc way".

Organisational data indicated the presence of mechanisms that classified and activated procedures and resources from local to federal level according to the nature of the incident. However the degree of coordination between these levels during the management of disasters was called into question by interviewees. According to one participant:

"There is certainly scope to optimise coordination between NCEMA and other national agencies and actors at local level such as the police who have significant responsibility for crisis response. There needs to be regular review of how we can improve coordination processes that ensures that we have a common and efficient response to emergencies at any level".

Participants further identified that coordination procedures are primarily focused on the response stage once a crisis has occurred and there were few processes or activities that focused on developing coordination in emergency preparedness between local and national levels. Interviewees indicated that multiple different projects at Emirate and national level were currently being implemented that additionally challenged coordination between levels in terms of integration within a single framework.

Analysis of the primary data pointed to further issues for coordination linked to disparities between Emirates in terms of underdeveloped infrastructure, lower quality construction, and reduced levels of education. According to interviewees these differences potentially impacted on the capability of national and regional structures to coordinate and operate together in the event of a crisis. This perspective was consistent with organisational documentation which showed that civil defence capabilities differ markedly between richer Emirates with increased levels of technological sophistication, equipment and local government support in comparison with poorer Emirates.

The interview data revealed multiple barriers associated with communication and information management aspects and how these operated within the UAE's framework for crisis readiness and response. The most consistent theme was a significant underdevelopment of information sharing practices between crisis response agencies and other actors. While certain information was routinely shared, interviewees identified substantial scope for greater

and broader sharing of information and knowledge among not only crisis response organisations but also with NGO and volunteer organisations and the public. Lack of developed information sharing practices was linked to reduced levels of crisis readiness overall and decreased public awareness of appropriate readiness and response activities.

Interviewees attributed the underdevelopment of information sharing within the crisis response system to several different issues. The primary reason was an absence of established policies and regulations that provide direction for the management and exchange of information between crisis response organisations and actors and that guide data sharing and protection. Interviewees indicated that this resulted in significant uncertainty for managers and employees in terms of understanding what can and should be shared and led to an overall lack of information sharing and knowledge exchange unless where clearly mandated. This was summarised by one participant:

> *"While some policy guidance does exist for sharing information and data between public sector agencies this is limited and not always specifically tailored to the crisis or disaster management context. There is even less guidance available for sharing information with external civil organisations for example, therefore to avoid data breaches managers generally tend to stick to sharing information only when policies are clearly established for them to do so".*

Analysis further indicated that cultural factors could negatively influence information sharing and knowledge exchange within the crisis response system linked to power, clandestineness and trust. Firstly in UAE organisations personal knowledge and expertise was identified to represent a source of status and rank gained from education and professional experience. Participants suggested that as a result individuals could be reluctant to give up their status as holders of specialised knowledge by making it freely available to others. There was a belief that this factor on occasion restricted knowledge sharing that could be useful to enhance crisis readiness capabilities more widely among a greater number of responders. One participant cited on this theme:

> *"In my department there is a noticeable culture around specialist capabilities that anything in that specialist area goes to that specific person or expert to deal with and they make the decisions on that, there isn't much discussion with other parties or inclusion of other people in the department that could help to extend knowledge in those areas".*

Another participant confirmed:

"In certain specialist areas we rely significantly on the expertise of a few individuals but there isn't much joint planning or decision-making in those areas – this is definitely their turf".

Attention was further drawn to the influence of hierarchy within organisations on knowledge sharing:

"I think employees can sometimes be reluctant to question their superiors or try to obtain further information than that provided by them because they don't want to appear contradictory or questioning competences in any way".

Secondly, trust was identified to be a significant antecedent for information and knowledge sharing to take place between crisis response organisations. Participants underlined that in many cases individuals in the multi-agency response system had limited experience of working together which meant that few interpersonal and trust relations had yet developed when responding to a road crisis. This was perceived to be somewhat problematic as the frequently sensitive or confidential nature of the information meant that it was mainly shared only when official sanction had first been obtained, which made information sharing processes more cumbersome and slower. According to certain participants this was also influenced by cultural factors in terms of an inherent tendency towards sharing information predominantly in the context of family relations and close personal relationships and associates. One participant summarised:

"As Arabs we are naturally more guarded with people outside our own personal networks and tend to be careful with the information we share. This can potentially cause bottlenecks in the system if this is allowed to influence practices".

Furthermore, participants pointed to the potential to optimise aspects of organisational culture among emergency service organisations to enhance knowledge sharing between them. A key measure identified was the development of incentives to promote and encourage knowledge sharing between responding organisations based on recognition and awards of organisations and departments that have developed effective knowledge sharing policies and practices in this field.

The results of the qualitative analysis identify several barriers to enhancing public education and awareness of the risks and threats. The primary data pointed to an insufficient number and breadth of public education programmes to effectively raise awareness within the population of possible risks and hazards. A specific obstacle was a lack of a defined strategy or policy for public education and an absence of definition of roles and responsibilities for this component. Interviewees indicated that as a result there was inadequate coordination between local and national entities, overlapping efforts and diverse plans and approaches across crisis response agencies to developing and implementing public education. One participant expressed the view that:

"As yet we have limited development of a strategic approach or programme towards public education for crisis readiness. Mainly we focus on the response stage and communication with the public once a crisis has happened to keep them informed and updated. While we have dedicated media units these focus on communicating with the public through the media and not directly. So basically we have gaps both in educating the public to be prepared for crises and in having dedicated resources for direct communication to the public once a crisis has occurred".

Moreover, the interviewees identified challenges to public education in the significant diversity of nationalities resident in the UAE which meant that programmes needed to accommodate a wide range of languages, cultures, religions, beliefs and attitudes. The impact on organisational resources and budgets emerged as a key issue as multiple elements needed to be considered: content and messaging which could be understood by all residents, methods and channels to ensure that both preparedness and early warning communications reach all of the population, and understanding of how different belief systems would affect community responses to crises and emergencies that shapes preparedness and response communication policies and strategies. According to one participant:

"The first thing is that we need to ensure that any communications we send out are multilingual in the languages like English and Urdu that are likely to reach the highest majority of the population. With the early warning system multiple languages have been embedded however I think there are still gaps. We also need to focus on ensuring that awareness and preparedness messages are reaching all parts of the community. Campaigns like the speeding awareness campaigns Haseb need to be properly assessed to understand the impacts and their reach".

Several issues were identified from analysis of the qualitative data in respect of early warning systems (EWS). Interviewees consistently pointed to a major barrier in respect of low levels of understanding of an EWS and its different components and how they related or overlapped with each other. This was attributed primarily to its relatively recent introduction into the UAE crisis readiness framework:

"An EWS has only been integrated within the last couple of years and when examining EWS in other countries it's obvious there are gaps and we still have many aspects to implement. However we need first to increase our knowledge and understanding of what those elements are, such as community surveillance and feedback for early warning, and how they would operate together in the UAE context".

Another interviewee stressed:

"We are implementing early warning and alert systems but these need to be better integrated at local, federal and regional level. Also we need to improve our understanding of the mechanisms and alert systems that ensure we reach all communities across multiple channels for warning".

Interviewee responses indicated that a lack of knowledge in relation to a comprehensive early warning system had implications in terms of undermining the preparedness of populations and crisis readiness efforts.

The qualitative data revealed that risk assessment and hazard management were confronted by a number of barriers that undermined the effective development and implementation of these components within the UAE's strategy for crisis readiness. In particular analysis of the primary data identified cultural and religious factors which represented a key challenge. Interviewees indicated that in Arabic and UAE culture, natural and other disasters were fatalistically perceived as random, singular events for which individuals are unable to control or prepare and plan for. Disasters are predominantly perceived as Acts of God, a punishment, and therefore for many Emiratis risk was most effectively mitigated through religious observance. The influence of this outlook was associated with greater vulnerability of the UAE population to crises and hazards and a lower level of awareness of risks and natural hazards and how these might be mitigated.

"There is significant scope to promote greater awareness among the population that events and disasters may happen and we don't always know when but that doesn't mean

we can't be prepared for them, so it's a question of subtly changing attitudes and perspectives and consistently messaging and educating on what can be done to prepare".

These results underline that even in a developed Islamic country there is a significant imperative to consider and address cultural and religious contexts and factors in developing an effective crisis readiness framework.

Inadequate skills, knowledge and awareness for effective risk identification and risk assessment emerged as a major barrier to enhancing crisis readiness and response. Interviewees cited an absence of appropriate training in risk assessment methods and techniques that could support increased levels of expertise within departments and agencies. Furthermore policies in relation to risk assessment were identified to focus solely on NCEMA and few existed to guide risk assessment in other crisis response organisations. Limited processes were established that promoted the development of researchers to undertake research for risk identification and evaluation:

"Building our skills in risk management and assessment is absolutely critical if we want to progress effectively in preparing for crises and emergencies; we need accurate identification of risks and their likelihood based on research to be able to prioritise resources and training better".

Interviewees further identified that barriers existed in a lack of a risk culture among crisis response organisations that led to a degree of complacency or even ignorance towards crisis risks and towards adopting new risk assessment and hazard management policies and strategies. This was found to undermine the effective implementation and standardisation of risk identification and evaluation.

Data from interviewees also pointed to gaps and challenges in the legal and regulatory context that impacted on legal preparedness to address crisis and emergencies. Consistently mentioned was an overall reliance on administrative guidelines and instructions in relation to crisis response as there was an absence of established laws and regulations in this area. This in turn created uncertainty and confusion among managers and decision-makers especially when operating in cooperation with other crisis organisations in terms of understanding and defining roles and responsibilities and boundaries for key processes and procedures. According to one senior level interviewee:

"There is still a lack of regulations or legal mechanisms in key areas of the national response system that need to be developed to help solve operational ambiguities and overlapping chains of command. In many areas managers are relying solely on policies and procedures established informally to an extent between agencies and there isn't always clear guidance".

In terms of recovery initiation a key barrier was the centralisation of this responsibility within the sole agency of NCEMA. Interviewees indicated that as this body already had an extensive remit this was likely to lead to delays in recovery and reconstruction in the event of major crises and disasters.

Documentary data indicated that property protection is a core stated aim of NCEMA and one of its key planning considerations. The primary qualitative data however showed a number of different barriers to implementing property protection throughout all stages of a crisis. As with other dimensions of crisis readiness interviewees underlined a major gap in the development of regulations and policies that promoted the protection of property. While some protection measures such as construction standards had been established, these related mainly to the pre-crisis phase and few policies or regulations had been formulated which provided specific guidance on how to protect property and infrastructure during and after crises had occurred. One participant cited:

"There is a gap in the response system in terms of legal mechanisms that focus on property protection and clear definition of measures that need to be undertaken and whose responsibility it is. Frequently only informal policies and procedures are available to support decision-making and guidance is lacking".

Analysis of all the qualitative data revealed that the application of key performance indicators (KPIs) to monitor crisis readiness and response performance was associated with several challenges. Firstly although organisational data shows that key performance indicators have been formulated to assess crisis readiness, the primary qualitative data identified a need to maximise understanding among crisis readiness decision-makers on how to effectively apply the KPIs to monitor and measure and how to use the results to enhance crisis planning and response. One interviewee noted:

"There remains a lack of regulations and legal mechanisms that can help to iron out operational ambiguities and much of the overlapping chain of command. In many different

areas managers depend on frequently informal policies and procedures and there is very little clear guidance".

Interviewees highlighted a misalignment between the results of the KPIs and the measures undertaken to improve crisis readiness which frequently failed to link to the areas indicated for improvement by the indicators.

6.3 Delphi Panel Phase 1

This section presents the results from thematic analysis of the first round of the Delphi process and data gathered from unstructured online questionnaire to obtain qualitative data from participants about what subcriteria and key performance indicators for each of the sixteen crisis readiness criteria they considered important for improving road traffic response times. The results are presented in accordance with the themes arising from thematic analysis. Section 5.3.13 presents the key performance indicators identified for each factor.

6.3.1 Information Management and Communication

For information management and communication there was consensus among the majority of the panel that technologically advanced communication systems and capabilities were operationally essential. A number of respondents identified key components for an effective communication system that included traffic analysis, location tracking capabilities, real-time multi-channel digital communications, and equipped centres. Training measures were advocated by nearly a third of panel members to enhance communication performance among centre employees and first responders. One respondent proposed multilingual training as a key frontline measure. A small number of the panel referred to inter-agency communication and collaboration and proposed different measures to promote it: identifying appropriate strategies and policies that would facilitate the management of inter-organisational communications, and diverse modes of inter-agency collaboration. This latter measure was suggested to be critical for continuous development and knowledge sharing.

6.3.2 Risk Assessment

For risk assessment three mechanisms of risk identification, evaluation and documentation can be identified from the findings. A third of the panel members recommended measures focused on risk assessment in which risks should be classified and categorised according to specific criteria. A small number of respondents suggested risks should be classified according to the probability of occurrence and the degree of impact, while a single participant emphasised

the use of established risk assessment models and statistical risk analysis as critical for accurate risk assessment. A minority of panel members furthermore suggested measures that focused on risk identification in terms of distinguishing frequent incidents and hotspots. In regards to risk documentation there was minority support for the creation of a risk register for potential traffic crises. One panel member perceived this as a first step towards developing capabilities and readiness for rapid response. A number of respondents distinguished either climatic conditions and resources or both as influential for road traffic crisis risk assessment. Two dimensions were identified as important for climate risk assessment in terms of knowledge of how to respond to different weather conditions and consideration of climatic conditions during crises. For resources a small minority of participants identified availability and distribution as risk factors.

6.3.3 Resources

In relation to resources three overarching dimensions of human resources, physical resources and technological resources emerged from the findings. Respondents emphasised efficiency and effectiveness in these areas could reduce road deaths and injuries and property damage. A large majority of panel members stressed the importance of effective human resources, noted by one participant as fundamental to the effective functioning of all other resources. Some respondents identified specific elements as necessary to the human resources dimension: traffic patrols, rescue teams, civil defense and national ambulance. A third of respondents emphasised the training and development of human resource capacities and capabilities. This development should be characterised according to one participant by the integration of both theoretical and field training in traffic crises for all response teams. A minority of participants stressed the importance of physical resources to effective crisis response. Respondents cited a number of elements required for physical resources of operations centres and identification of efficient traffic crisis response routes. A further minority advocated for advanced technological resources in terms of the incorporation of wireless technologies, devices and applications and artificial intelligence in coordination with all relevant authorities.

6.3.3.1 Logistic and Facilities

A view emerged from the majority of panel members that the logistics and facilities criterion was closely related to that of resources, to the extent that some participants mentioned this criterion as ultimately subsumed by resources. However there was some consensus among respondents in relation to two aspects of the logistics dimension. Over half of participants proposed logistics planning as a critical aspect and contributed different measures for effective

planning. Clearly defined logistical support plans were emphasised by a number of respondents that provided for appropriate geographical distribution of logistic response systems, ensured business continuity, and accounted for recovery phases. Planning should align with risk assessment and risk classification systems for road traffic and broader crises. A third of respondents affirmed the significance of maintenance and routine inspection of equipment and facilities for continuity of response. Panel members stressed different aspects of maintenance as essential for effectively addressing diverse crises that included maintaining up to date, multi-use logistics systems equipped with advanced technology and appliances.

6.3.4 Co-ordination

Results showed that there was majority consensus among panel members on specific dimensions of the coordination criteria. Over half of participants supported the necessity of centralised coordination and engagement across relevant agencies, and some respondents proposed specific measures in terms of shared operation centres, operational management procedures and dedicated teams. A further majority advocated for measures related to interagency coordination that included agency liaisons, creating partnerships among key actors, information and data sharing protocols, and ensuring system compatibility. Such measures were noted by one participant to have the potential to provide holistic and real-time information to support rapid response. In the view of another an exchange of liaison officers and representatives was important for maintaining relationships and enhancing coordination. A large minority of panel members identified aspects of communication as essential to effective co-ordination, and suggested measures which address two different types of communication of inter-agency and public. Collective training was a further dimension cited by participants focused on joint exercises and activities to contain and manage road traffic crises.

Panel members advocated several aspects of organisational structures and stakeholder relationships to improve coordination. Some participants stressed that administrative arrangements should reflect the level of crisis and contain dedicated structures and teams specifically focused on the management of road traffic crises. Tasks and responsibilities should be clearly defined and regularly monitored and reviewed. A further minority cited operations management as a key practice to enhance the efficiency of crisis response structures. In respect of stakeholders a number of respondents identified critical actors across the UAE public sector and local government among whom partnerships should be maintained: Ministry of Infrastructure Development, Roads and Transport Authority, Directorate of Traffic and Patrols, public transport agencies, national ambulance and rescue authorities, local municipality

partners responsible for the development of road infrastructure and the National Center of Meteorology.

6.3.4.1 Operations and Procedures

Responses for coordination and operations and procedures were overlapping and a large minority of panel members noted that these criteria were highly similar. Despite this several specific subcriteria for operations and procedures can be identified in the results. There was minority consensus in relation to operational planning and the creation of plans that specified procedures and processes for different types of events. Several respondents further advocated the establishment and maintenance of highly equipped centres for operations (COP). The COP should be composed of representatives from all the key agencies and disciplines with clear established lines of responsibilities for all operational activities. Another panel member characterised the nature of operational procedures citing the necessity of specifying inter-team and inter-organisational arrangements and responsibilities.

6.3.5 Response Planning

Four key processes or subcriteria emerged from the results as significant for the response planning criteria. A small majority of participants considered the critical elements of response plans and proposed different aspects for integration including resource planning and variables impacting response times. A further dimension related to the process of response planning, which just over a third of respondents indicated should be collaborative leading to integrated and joint plans among authorities. A number of participants in addition placed emphasis on the regular review and update of response plans.

Qualified and skilled human resources were identified as a key factor by a third of participants and associated with development processes that should have specific characteristics: joint training; development of real-life training scenarios, and evaluation of scenario outcomes to assess plan effectiveness. This was noted by one respondent to enhance readiness across different areas including communications, resources and operating procedures.

There was a minority consensus that clearly defining roles, tasks and responsibilities among all actors was a key process. According to one participant this would avoid duplication of resources and efforts. In this regard ensuring distributed decision-making powers among relevant actors was viewed by another to support team working. Different factors were cited by a number of participants that should be accounted for in response planning: traffic volume,

population density, road infrastructure challenges, geographical distance, infrastructure, and available resources.

6.3.6 Training

Responses for training, exercises and crisis leadership development are grouped together reflecting a perception among most panel members that these were closely linked aspects or levels of training. All of the subcriteria proposed by participants for the training criteria focused on the type and character of training that should be delivered. A large minority of members stated that training should be practical and hands-on that prepared responders for unexpected or challenging scenarios in the field. Field training should be specialised and advanced and specifically focus on road traffic crises and response times. The integration of joint exercises and training programmes within the overall training mix were proposed by over a third of participants. This was perceived to provide opportunities to exchange experiences among crisis actors and to develop inter-agency coordination processes. A further third of respondents identified the importance of technology and equipment training that maintained the skills of first responders on advanced technologies. A small number of participants advocated theoretical, classroom-based training in addition to practical training programmes. One participant suggested that adoption of best practice training programmes and standards from developed countries could help to incorporate relevant experience and lessons.

6.3.6.1 Exercises

For exercises a number of components were identified to contribute towards an effective programme that could enhance crisis response. There was support among a third of participants for diverse exercises that encouraged adaptiveness and flexibility in operational responses. For one respondent there was value in the integration of different climatic conditions and diverse scales of crisis and traffic management strategies. A similar number of panel members recommended the routine inclusion of technically advanced programmes that integrated virtual simulations, enhanced reality and/or artificial intelligence to provide authentic experiences within a simulated environment. A minority of respondents stressed inter-agency exercises were important that could help to determine roles and define lines of responsibility. Exercise plans should be collaboratively developed to ensure relevancy and authenticity for all actors. Participants identified the investigation, implementation and benchmarking of international best practice in crisis exercises. Furthermore a database of resources and capacities of all actors involved in crisis response was cited as a key mechanism to support exercise processes.

6.3.6.2 Crisis Leadership Development

There was consensus among a majority of the panel that crisis leadership development was a critical factor for enhancing crisis readiness. Crisis communication emerged as the single most significant area of development followed by development of leaders in terms of psychological and emotional competencies for supporting staff in stress management and maximising staff resilience in the face of stressful situations. Multiple participants suggested firstly that leadership development should be associated with key competencies for crisis leadership and secondly be based on a continuous programme using different modes of learning and development as well as international study and secondments.

6.3.7 Hazard Management

A view emerged among panel members that hazard management and risk assessment were similar criteria with intersecting components. This was supported by the results as a large proportion of the measures proposed reflected a risk assessment approach. For a majority of participants, the identification and analysis of potential hazards was the most significant factor. This was linked by respondents to prioritisation of different risks to address hazard management that included assessing the ability to respond. There was some consensus in relation to additional measures that advanced beyond risk management. A minority agreed that hazard-specific training should be provided focused on identified risk priorities to support responsiveness in hazard situations. A similar number cited hazard planning as an important factor that should establish security protocols, and preventive action based on analysis of the causes of traffic congestion and accidents.

6.3.8 Public Education and Information

Public education and information was associated with the broad dissemination of knowledge and information based on certain factors and processes. The use of diverse forums for communication with different audiences was advocated by nearly half of respondents that included crisis education courses and programmes, and workshops and meetings to engage with public, employees, and personnel in related areas or disciplines. In terms of content, a smaller minority considered the transfer of best practices for ensuring public safety critical in allowing the public to respond appropriately to crises.

6.3.9 Legal and Institutional

A majority of panel members considered a supportive legal framework as a critical factor in crisis response. Respondents advocated for the development of policies and regulations

specifically focused on and supporting crisis readiness and response including measures for prevention. Around a third of participants stressed the necessity for regular review and updating of legislation related to traffic crisis response. Panel members moreover linked ongoing monitoring and evaluation and collaboration between crisis actors that could inform decision-making. A single participant stressed the importance of a legal framework that was evidence-based drawing on operational data and analysis to support the development of regulation.

6.3.10 Recovery Initiation

For recovery initiation there was consensus among a majority of the panel members that recovery and continuity planning was a critical element for commencing rapid and efficient recovery. Plans should be flexible to address crises of varying scales and impacts and focus on continuity of essential infrastructure and facilities. A minority of participants characterised effective planning processes in terms of the engagement and participation of public and private sector bodies responsible for key services and infrastructure. Partnership agreements with responsible bodies were proposed as an essential mechanism in this respect. A small number of respondents stressed the importance of accurate loss and damage assessment. For a further minority review of recovery initiation performance was a key aspect that would provide opportunities for learning and improvement.

6.3.11 Early Warning Systems

The panel identified several critical elements for early warning systems. All respondents advocated that the early warning system (EWS) should be based on advanced digital information and communications that are accessible by all agencies and the public. Participants further identified specific key elements that would contribute to an advanced warning system. According to the majority of the panel the system should collect data from multiple sources and monitor different types of road traffic risk factors and related factors. One participant further stressed that data collection and monitoring mechanisms should integrate artificial intelligence and data mining techniques to perform automatic collection and analysis of data. Another respondent emphasised that the system should be capable of activating rapid communications and triggering action in operational responses by teams. Half of the respondents stated that EWS should be integrated into mosque communication systems to establish a targeted general alarm system. EWS procedures should define warning protocols for each type of event and specify all media communication contacts or systems. Social media was cited by the majority of panel members as a key aspect of the EWS to ensure effective

integration into public social networks. There was strong consensus among respondents on the importance of multiple mechanisms of communication, multi-lingual content and messages in a clear and understandable format that should reach the entire population or specific geography including hard to access groups.

6.3.12 Property Protection

The results showed that the majority of participants advocated the protection of critical infrastructures that could be affected by road traffic crisis. The key elements emphasised were identification of any public assets, infrastructures or installations in the operations zones and procedures established for each type of risk: fire, chemical, water. A critical measure for half of participants was operations centre access to information systems and contact information for any critical or significant infrastructures. Furthermore a minority of panel members stressed the importance of raising property protection awareness among first responders.

6.3.13 Performance Indicators for Critical Dimensions

For each factor the Delphi panel participants advanced a number of indicators that would inform and are considered important for evaluating and enhancing crisis readiness as shown in Table 6-1.

Table 6-1 Sub criteria and Performance Indicators

Criteria	Sub-Criteria	Performance Indicators
Information Management and Communication	Advanced communication systems	Information and communication system; % of smart applications in incident reporting; reporting response time
	Multi-channel communications	Number and relevance of mechanisms; Public and community mechanisms; Social Media; number of languages; Information co-ordination mechanisms
	Inter-agency-collaboration	Information co-ordination mechanisms
	Multiple incident reporting	Number and relevance of information and reporting mechanisms; Data collection mechanisms; relevant and timely data
	Strategies and Policies	Trained media response units established
Risk Assessment	Identifying Risks	Risk communication plan
	Evaluating risks	
	Documenting risks	Times risk register reviewed; All hazards risk register
	Forecasting and modelling	
	Assessing climatic risks	
	Assessing resource risks	
Resources	Human Resources	Ratio of qualified human resources to total staff in operation centres
	Physical Resources	Resource coverage ratios on scene; Budget plans developed; Budgets allocated; Availability of funding
	Advanced Technological Resources	Availability of technical resources
Coordination	Centralised Coordination Systems	Emergency operations centre established
	Public Communication	Public and community coordination mechanisms
	Interagency Coordination	Inter-agency coordination mechanisms; Number of coordination meetings between partners
	Joint Training	
	Communication	
Response Planning	Joint Response Planning	Coordinated planning processes
	Resource Planning	
	Roles and Responsibilities	Qualified planners

	Regular Review and Update	Continuous Planning
Training	Field Training	Appropriate continuous training
	Joint Exercises	Completion of inter-agency multi-hazard capacity assessment to prioritise training
	Training Programmes	Training schedules developed; Number of training courses; Number of exercises, workshops and specialised courses; Ratio of accredited training programs to number of programs implemented;
	Theoretical Training	Training modes implemented
	Adoption of Best Practice	Training and capacity standards in place and disseminated to all relevant stakeholders; Indicators evaluating the impact of training
	Equipment Training	
	Technology Training	Training materials
Exercises	Virtual Simulations	Use of virtual, AI and simulation technologies
	Benchmarking against best practice	Observation and evaluation of exercises
	Diverse Exercises	Frequency and type of exercises/simulations implemented
	Inter-agency Exercises	Exercise programme
	Database of Resources and Capacities	Performance of personnel during exercises
Hazard Management	Hazards Analysis	Identification and assessment of hazards; Monitoring of hazards
	Hazard Management Planning	Proportion of plans for specific risks; Percentage of updated plans for specific risks; Hazard warning system; Percentage of measures actioned; Number of risks managed effectively and efficiently in relation to total risk
	Hazard-Specific Training	
	Role Identification	
Logistics and Facilities	Logistics and Facilities	% coverage of logistics support for responders; Rate of interruption to response operations caused by insufficient logistical support
	Maintenance of Logistics Systems	Maintenance and periodic inspection of response vehicles
	Logistics Planning	Facilities and equipment allocated
Public Education and Information	Education Programmes	Public education programmes implemented
	Diverse Communication Forums	Multiple information and communication mechanisms
	Transfer of Best Practice	Multilingual content

Legal and Institutional	Supportive Legislative Framework	Legal framework for institutional arrangements, policies, operations and funding; Mechanisms to enforce compliance; Legislation for finance;
	Evidence-based	Quality of legal frameworks in dealing with traffic crises
	Collaboration	Mandates defining roles and responsibilities
	Regular Review and Update	Percentage of laws modified to address traffic crises
Operations and Procedures	Operational Planning	Operational protocols for each type of crisis; Role and responsibilities
	Centres of Operations	Equipped operations and command centre
	Coordinated Operational Procedures	Operational information exchange mechanisms; Institutional arrangements operational procedures
Recovery Initiation	Recovery and Continuity Planning	Recovery plan; Recovery priorities identified; Plan for restoration of critical services and facilities
	Cross-sector Agreements	
	Loss/damage Assessment	
	Performance Evaluation	
Property Protection	Critical Infrastructure Planning	Critical infrastructures and public properties identified; Roles and responsibilities identified
	Prevention of Property Damage	Communication mechanisms with critical infrastructures
	Property Protection Legislation	Property protection protocols established
	Property Protection Awareness	
Early Warning	Advanced Warning System	Early warning system; Speed of sending public warning messages through integrated electronic systems
	Comprehensive Intelligent Monitoring	Data collection and monitoring mechanisms
	Alarm Systems	Number of times ES tested and updated
	Social Media	Public communications/social media integrated into EWS
	Communication	Diverse communications and warning mechanisms; clear and appropriate content
Crisis Leadership Development	Competency-based	Competency based crisis leadership training plan
	Continuous Development	Continuous professional development
	Crisis Communication	Competencies of crisis communication training
	Diverse Modes	
	Emotional Competencies	

6.4 Delphi Panel Phase 2

This section presents the results from the second round of the Delphi process and data gathered from a semi-structured questionnaire to obtain quantitative and qualitative data that could validate the criteria, subcriteria and performance indicators collectively generated in the first round. The summarised results of the thematic analysis were presented to participants to provide an opportunity for reflection, clarification and refinement and to rate and review each criterion as well as their associated subcriteria and performance measures. Opportunity was provided in the questionnaire for participants to provide feedback, thoughts and views on any of these elements. This process not only helped to identify areas of consensus but also to determine where some integration or streamlining of criteria, subcriteria and indicators was possible to ensure the manageability of the AHP process in the following round.

In particular, participant responses showed a level of consensus that there was some overlap and similarity between certain criteria. The implication for this study is that in the next round of AHP analysis pairwise comparison of highly similar concepts could be problematic and lead to conflicting results, undermining identification of the most important criteria. Some participants pointed to significant overlaps between the criteria of Risk Assessment and Hazard Management. Other participants noted that Exercises and Crisis Leadership Development were components of the overall theme of training rather than distinct criteria. Moreover significant overlap was noted by a majority of participants between the criteria of Coordination and Operations and Procedures, and between Resources and Logistics and Facilities, with the latter noted as a subtheme of Resources. From the perspective of some participants Public Education and Communication was a component of the Information Management and Communication criteria. Based on these results certain criteria were integrated to form new more comprehensive criteria and reducing the overall number of criteria from sixteen to ten for the next round of AHP analysis. These were: Risk and Hazard Assessment; Legal and Institutional Frameworks; Resources & Logistics and Facilities; Coordination & Operations and Procedures; Information Management and Communication & Public Education; Response Planning; Early Warning; Training, Exercises, Crisis Leadership Development; Recovery Initiation; and Property Protection.

6.5 Conclusion

This chapter presented the results and analysis for the qualitative phase of this study. Two sets of qualitative data were gathered from across two rounds of the Delphi process and secondary data. Results of the first round of the Delphi process and data gathered from an unstructured online questionnaire to obtain qualitative data was thematically analysed. This resulted in identification of subcriteria and key performance indicators for each of the sixteen crisis readiness criteria that were considered important for improving road traffic response times. Themes were identified in respect of the barriers that impact on the role of law enforcement agencies within crisis and disaster management. In the second round of the Delphi process data gathered from a semi-structured questionnaire to obtain quantitative and qualitative data was subject to thematic analysis to provide initial qualitative validation of the criteria, subcriteria and performance indicators collectively generated in the first round. Quantitative analysis and thematic analysis of the qualitative data was conducted to determine the rationale and justification for the rating and priority given to key elements. The resulting list of criteria, subcriteria and performance indicators provided the inputs for the empirical evaluation in the next phase based on the Analytical Hierarchy Process. The results from the quantitative analysis of the AHP and empirical stage of the Delphi processes are presented in the next chapter.

CHAPTER 7: CRISIS READINESS – AHP RESULTS

7.1 Introduction

This chapter presents the results of a novel implementation of the AHP framework that aims to identify, prioritise and select criteria, subcriteria and performance indicators critical for improving crisis readiness and response times using the evaluations of experienced practitioners in the field. The results from Round 3 of the Delphi Panel using the Analytical Hierarchy Process present criteria, subcriteria and key performance indicators evaluated as most important for optimising road traffic response times. The initial sections of this chapter provide an overview of the analytic procedures followed and the validity and reliability of the AHP results. The final sections present the findings validating the final strategic framework for improving road traffic crisis response times.

7.2 Overview of AHP Procedures

The quantitative data was analysed systematically in line with established and standardised procedures for the Analytical Hierarchy Process. Analytical procedures comprised four main steps of: defining the hierarchical framework; the conduct of pairwise comparisons to collect the data and establish priorities; synthesising and calculating the judgements of participants to obtain a set of prioritised weightings for achieving the goal, and evaluation of the consistency of the results (Cabala, 2010; Al-Shehri et al., 2015).

In the first step a hierarchical framework was constructed that consisted of ten criteria for crisis readiness based on the literature review that pointed to the existence of sixteen key dimensions of crisis readiness. In earlier Delphi phases participants provided qualitative feedback on the key relative importance of these sixteen criteria. A final ten criteria were shortlisted and formed the basis of the hierarchical framework for the AHP: Risk and Hazard Management; Legal and Institutional Frameworks; Resources; Coordination; Information Management and Communication; Response Planning; Early Warning; Training; Recovery Initiation, and Property Protection.

Members of the Delphi panel performed the next step and evaluated the priority of the ten criteria presented conducting a pairwise comparison. Members completed a pairwise comparison matrix to indicate the relative priority or importance between items for achieving the goal (Tahriri et al., 2008). To determine the ranking and relative importance of the criteria

participants evaluated the lesser or greater priority of each criteria against all of the others using a numerical nine-point scale.

The data from participants provided the basis for the next stage which would result in a ranked list of criteria in terms of relative importance, otherwise known as the priority vector or eigenvector. This was achieved by firstly calculating and synthesising the scores using the geometric mean method that resulted in the attribution of priority weightings to each criterion. Secondly, to obtain one representative group priority vector which synthesised the results for all participants, the individual priorities of each participant were averaged using the weighted geometric mean (Dolan et al., 1989). These steps were performed for all three levels of the hierarchical framework to also identify the importance of the subcriteria and performance indicators associated with each of the criteria. Pairwise comparison of subcriteria and performance measures was conducted for the top six criteria only: response planning, resources, training, coordination, information management and communication and risk and hazard management. It was not practical or feasible to conduct pairwise comparisons for all the subcriteria and indicators for each of the ten criteria which would have involved the completion of 20 or more matrices and the comparison of hundreds of individual items. The results formed the basis for the development of the overall priority rankings for the criteria, subcriteria and performance indicators for crisis readiness. The final step involved evaluating the results for consistency by calculating the consistency ratio using the consistency index and the random index.

7.3 Pairwise Comparison Results

7.3.1 Crisis Readiness Criteria

Participants were first requested to prioritise the importance of ten criteria of crisis readiness of Risk and Hazard Management; Legal and Institutional Frameworks; Resources; Coordination; Information Management and Communication; Response Planning; Early Warning; Training; Recovery Initiation, and Property Protection. Analysis of the pairwise comparison for Crisis Readiness criteria shows that the Response Planning criterion was considered the most important by participants, with a priority weight of 17.3%. Table 7-1 shows that Resources indicated the next highest priority of 15.4% followed by Training with a weight of 14.7%. Coordination, Information Management and Communication and Risk and Hazard Management were ranked fourth, fifth and sixth respectively. Recovery Initiation and

Property Protection were considered the two least important criteria. The consensus responses notably conformed with acceptable CR requirements.

Table 7-1 Crisis Readiness Criteria

Criteria	RHM	LIF	RES	CRD	IMC	RP	EW	TRN	RI	PP	Priority Vector	Relative Weights %
RHM	0.07	0.14	0.05	0.15	0.03	0.04	0.10	0.15	0.12	0.11	0.096	9.6%
LIF	0.02	0.05	0.04	0.05	0.02	0.09	0.10	0.05	0.08	0.06	0.055	5.5%
RES	0.21	0.19	0.14	0.15	0.17	0.09	0.15	0.15	0.12	0.17	0.154	15.4%
CRD	0.07	0.14	0.14	0.15	0.17	0.18	0.15	0.15	0.12	0.14	0.141	14.1%
IMC	0.21	0.19	0.07	0.07	0.09	0.06	0.15	0.08	0.12	0.11	0.114	11.4%
RP	0.28	0.09	0.29	0.15	0.26	0.18	0.10	0.15	0.12	0.11	0.173	17.3%
EW	0.03	0.02	0.05	0.05	0.03	0.09	0.05	0.04	0.12	0.09	0.056	5.6%
TRN	0.07	0.14	0.14	0.15	0.17	0.18	0.19	0.15	0.16	0.11	0.147	14.7%
RI	0.02	0.02	0.05	0.05	0.03	0.06	0.02	0.04	0.04	0.06	0.038	3.8%
PP	0.02	0.02	0.02	0.03	0.02	0.04	0.02	0.04	0.02	0.03	0.026	2.6%
											CR value: 0.06 < 0.10 (consistent)	

Key: **RHM** = Risk and Hazard Management; **LIF** = Legal and Institutional Frameworks; **RES**=Resources; **CRD** = Coordination; **IMC** = Information Management and Communication; **RP** = Response Planning; **EW** = Early Warning; **TRN** = Training; Exercises; Crisis Leadership Development; **RI** = Recovery Initiation; **PP** = Property Protection

These results formed the basis for the next step of the AHP in which participants considered the priority of the different subcriteria identified in earlier rounds of the Delphi. The six criteria accorded the highest priority weights by participants were selected from the overall ten for the next round of the AHP: Response Planning, Resources, Training, Coordination, Information Management and Communication and Risk and Hazard Management. As shown in Table 6-1 in Level 2 each criterion is linked to subcriteria of the respective criteria. The next round aimed to achieve better understanding of the subcriteria associated with each of the six criteria through pairwise comparisons of the subcriteria proposed by respondents in the initial stage of research.

7.3.2 Response Planning Subcriteria

Based on the qualitative results from the initial rounds of Delphi, Response Planning had four subcriteria of joint response planning, resource planning, roles and responsibilities and regular review and update. As shown in Table 7-2 joint response planning and resource planning were both considered of equal importance by participants and accorded a priority of

36.5%. Roles and responsibilities ranked the second highest with a weight of 17.2% while regular review and update had the least weight of 9.8%.

Table 7-2 Response Planning Subcriteria

Response Planning Subcriteria	JRP	RESP	RR	RRU	Priority Vector	Relative Weights %
JRP	0.38	0.38	0.41	0.30	0.365	36.5%
RESP	0.38	0.38	0.41	0.30	0.365	36.5%
RR	0.13	0.13	0.14	0.30	0.172	17.2%
RRU	0.13	0.13	0.05	0.10	0.098	9.8%
					CR value: 0.07 < 0.1 (consistent)	

Key: **JRP** = Joint Response Planning; **RESP** = Resource Planning; **RR** = Roles and Responsibilities; **RRU** = Regular Review and Update

7.3.3 Resources Subcriteria

Resources had six subcriteria of human resources, physical resources, advanced technological resources, logistics and facilities capabilities, maintenance of logistics systems and logistics planning. These represented an amalgamation of the subcriteria associated with both Resources and Logistics and Facilities. The consensus responses presented in Table 7-3 show that the three highest priority subcriteria of human resources, physical resources and logistics and facilities capabilities were all considered of equal importance each recording a weight of 24.4%. Logistics planning recorded the lowest priority of 6.6%.

Table 7-3 Resources Subcriteria

Resources Subcriteria	HR	PR	ATR	LFC	MLS	LP	Priority Vector	Relative Weights %
HR	0.25	0.25	0.27	0.25	0.24	0.20	0.244	24.4%
PR	0.25	0.25	0.27	0.25	0.24	0.20	0.244	24.4%
ATR	0.08	0.08	0.09	0.08	0.16	0.13	0.106	10.6%
LFC	0.25	0.25	0.27	0.25	0.24	0.20	0.244	24.4%
MLS	0.08	0.08	0.05	0.08	0.08	0.20	0.096	9.6%
LP	0.08	0.08	0.05	0.08	0.03	0.07	0.066	6.6%
							CR value: 0.04 < 0.10 (consistent)	

Key: **HR** = Human Resources; **PR** = Physical Resources; **ATR** = Advanced Technological Resources; **LFC** = Logistics and Facilities Capabilities; **MLS** = Maintenance of Logistics Systems; **LP** = Logistics Planning

7.3.4 Training Subcriteria

Training, Exercises and Crisis Leadership Development criteria were initially associated with a total of 17 subcriteria following Rounds 1 and 2 of Delphi. Amalgamation of these criteria into a single Training criterion resulted in a reduction of the number of subcriteria to be compared by participants to ten. This was undertaken due to time constraints and practical challenges and the consideration that larger matrices requiring a high number of comparisons can result in lower levels of internal consistency (Carmone et al., 1997).

Table 7-4 Training Subcriteria

Training Subcriteria	FT	TT	TECH.T	ET	BP	EX	VS	IAE	RDC	CLD	Priority Vector	Relative Weights %
FT	0.16	0.30	0.13	0.13	0.09	0.13	0.15	0.24	0.12	0.15	0.158	15.8%
TT	0.05	0.10	0.13	0.13	0.09	0.13	0.04	0.12	0.12	0.15	0.104	10.4%
TECH.T	0.16	0.10	0.13	0.13	0.09	0.13	0.11	0.06	0.12	0.15	0.116	11.6%
ET	0.16	0.10	0.13	0.13	0.09	0.13	0.11	0.06	0.09	0.15	0.113	11.3%
BP	0.05	0.03	0.04	0.04	0.03	0.03	0.01	0.01	0.01	0.04	0.030	3%
EX	0.16	0.10	0.13	0.13	0.12	0.13	0.15	0.06	0.12	0.15	0.124	12.4%
VS	0.04	0.10	0.04	0.04	0.12	0.03	0.04	0.01	0.12	0.02	0.057	5.7%
IAE	0.04	0.05	0.13	0.13	0.12	0.13	0.15	0.06	0.12	0.02	0.095	9.5%
DRC	0.04	0.02	0.03	0.04	0.12	0.03	0.01	0.01	0.03	0.02	0.037	3.7%
CLD	0.16	0.10	0.13	0.13	0.12	0.13	0.23	0.36	0.18	0.15	0.166	16.6%
										CR value: 0.09 < 0.10 (consistent)		

Key: **FT** = Field Training; **TT** = Theoretical Training; **TECH. T** = Technological Training; **ET** = Equipment Training; **BP** = Adoption/benchmarking Best Practice; **EX** = Exercises; **VS** = Virtual Simulations; **IAE** = Inter-agency Exercises; **DRC** = Database of Resources and Capacities; **CLD** = Continuous Leadership Development

Subcriteria were eliminated or integrated based on similarities between them resulting in a final list of ten subcriteria for pairwise comparison as shown in Table 7-4. This meant that the subcriteria of joint exercises and training programmes in the Training criteria and two subcriteria of interagency exercises and collaborative development of exercise plans in the Exercises criteria became Interagency exercises; Adoption/benchmarking best practice was drawn from subcriteria in both Training and Exercises; three subcriteria were eliminated from Crisis Leadership Development of crisis communication, development of key competencies and psychological and emotional competencies; and diverse exercises that encouraged adaptiveness and flexibility in operational responses from the Exercises criteria and practical and hands-on training for unexpected or challenging scenarios in the field in the Training criteria became the exercises subcriterion.

Continuous leadership development was considered by participants to have the highest priority (16.6%), followed by field training (15.8%). Exercises, technical training and equipment training ranked third, fourth and fifth highest (12.4%, 11.6% and 11.3%, respectively) while adoption/benchmarking of best practice scored the lowest (3.0%).

7.3.5 Coordination Subcriteria

Based on the results of earlier rounds of Delphi Coordination and Operations and Procedures were amalgamated into a single criterion of Coordination. Of the eight subcriteria identified for these criteria two were eliminated as overlapping. Table 7-5 shows a pairwise comparison of the six Coordination subcriteria. Operational Planning was considered by participants to be the most important with a priority weight of 30.1%, followed by Coordinated Operational Procedures and Inter-agency Coordination which had priorities of 25.9% and 17.7% respectively. Public coordination ranked last with a weight of 5.2%.

Table 7-5 Coordination Subcriteria

Coordination Subcriteria	CCS	PC	IAC	JT	COP	OP	Priority Vector	Relative Weights %
CCS	0.08	0.21	0.05	0.11	0.07	0.08	0.097	9.7%
PC	0.02	0.05	0.04	0.04	0.07	0.10	0.052	5.2%
IAC	0.23	0.21	0.15	0.11	0.26	0.10	0.177	17.7%
JT	0.08	0.16	0.15	0.11	0.09	0.10	0.114	11.4%
COP	0.30	0.21	0.15	0.32	0.26	0.31	0.259	25.9%
OP	0.30	0.16	0.46	0.32	0.26	0.31	0.301	30.1%
							CR value: 0.07 < 0.10 (consistent)	

Key: **CCS** = Centralised Coordination Systems; **PC** = Public Coordination; **IAC** = Interagency Coordination; **JT** = Joint Training; **COP** = Coordinated Operational Procedures; **OP** = Operational Planning

Table 7-6 Information Management and Communication Subcriteria

Inf. Mgt and Comm. Subcriteria	IAC	MCC	ACS	MIRT	SP	PEI	DCF	TBP	Priority Vector	Relative Weights %
IAC	0.07	0.03	0.08	0.17	0.08	0.03	0.12	0.09	0.083	8.3%
MCC	0.20	0.10	0.06	0.13	0.11	0.08	0.12	0.09	0.110	11%
ACS	0.20	0.38	0.24	0.25	0.16	0.50	0.24	0.26	0.278	27.8%
MIRT	0.02	0.03	0.04	0.04	0.07	0.03	0.04	0.04	0.038	3.8%
SP	0.27	0.29	0.47	0.21	0.33	0.25	0.16	0.26	0.279	27.9%
PEI	0.20	0.10	0.04	0.13	0.11	0.08	0.24	0.17	0.133	13.3%
DCF	0.02	0.03	0.04	0.04	0.08	0.01	0.04	0.04	0.039	3.9%
TBP	0.03	0.05	0.04	0.04	0.05	0.02	0.04	0.04	0.040	4%
								CR value: 0.08< 0.10 (consistent)		

Key: **IAC** = Inter-agency Communication; **MCC** = Multi-channel Communications; **ACS** = Advanced Communication Systems; **MIRT** = Multiple Incident Reporting Types; **SP** = Strategies and Policies; **PEI** = Public Education & Information Programmes; **DCF** = Diverse Communication Forums; **TBP** = Transfer of Best Practice

7.3.6 Information Management and Communication Subcriteria

In the AHP analysis the Information Management and Communication criterion was integrated with the Public Education and Information criterion. This led to a total of eight subcriteria associated with Information Management and Communication of: advanced communication systems; multi-channel communications; inter-agency communication; multiple incident reporting types; strategies and policies; public education and information programmes; diverse communication forums and transfer of best practice. As

Table 7-6 shows strategies and policies had the highest weight (27.9%), closely followed by advanced communication systems (27.8%). Public education and information programmes and multi-channel communications ranked third and fourth (13.3% and 11%, respectively). The least important subcriteria was multiple incident reporting types (3.8%).

7.3.7 Risk and Hazard Management Subcriteria

Following Round 2 of Delphi the two criteria of Risk Assessment and Hazard Management were integrated into the single criteria of Risk and Hazard Management. The ten subcriteria identified for these two criteria were integrated to produce a total of five subcriteria of risk and hazard analysis, forecasting and modelling, documenting risks, hazard management planning and hazard specific training. Table 7-7 shows the rankings of the pairwise comparisons for these subcriteria. Risk and hazard analysis was accorded the highest weight (41.7%), while hazard specific training had the lowest (7.3%).

Table 7-7 Risk and Hazard Management Subcriteria

Risk and Hazard Management Subcriteria	RHA	FM	DR	HMP	HST	Priority Vector	Relative Weights %
RHA	0.44	0.29	0.51	0.53	0.31	0.417	41.7%
FM	0.15	0.10	0.06	0.06	0.23	0.118	11.8%
DR	0.15	0.29	0.17	0.18	0.15	0.188	18.8%
HMP	0.15	0.29	0.17	0.18	0.23	0.204	20.4%
HST	0.11	0.03	0.09	0.06	0.08	0.073	7.3%
	CR value: 0.08 < 0.10 (consistent)						

Key: **RHA** = Risk and Hazard Analysis; **FM** = Forecasting and Modelling; **DR** = Documenting Risks; **HMP** = Hazard Management Planning; **HST** = Hazard Specific Training

7.3.8 Response Planning Performance Indicators

Pairwise comparisons were undertaken for the performance indicators previously identified by respondents as essential to measure for the six highest ranked criteria. For the highest ranked criterion of Response Planning the priority of three performance indicators of coordinated

planning processes, qualified planners and continuous planning was compared. As shown in Table 7-8 coordinated planning processes had the highest weight of 56.4%, followed by continuous planning with 35.9%. Qualified planners had the least priority of 7.7%.

Table 7-8 Response Planning Performance Indicators

Response Planning PIs	CPP	QP	CP	Priority Vector	Relative Weights %
CPP	0.60	0.46	0.63	0.564	56.4%
QP	0.10	0.08	0.05	0.077	7.7%
CP	0.30	0.46	0.32	0.359	35.9%
	CR value: 0.06 < 0.10 (consistent)				

Key: **CPP** = Coordinated Planning Processes; **QP** = Qualified Planners; **CP** = Continuous Planning

7.3.9 Resources Performance Indicators

Resources had five performance indicators of qualified human resource ratios, funding availability, technical resources availability, facilities and equipment availability and periodic review and maintenance. As shown by the consensus responses in Table 7-9 qualified human resource ratios were considered by participants to have the most importance as shown by a weight of 41.5%, one of the highest of any performance indicator. Funding availability indicated the next highest priority of 27%, while technical resources availability and facilities and equipment availability were considered to have equal priority of 13.7%. Periodic review and maintenance attracted the lowest priority of 4.1%.

Table 7-9 Resources Performance Indicators

Resources PIs	QHRR	FA	TRA	FEA	PRM	Priority Vector	Relative Weights %
QHRR	0.46	0.62	0.37	0.37	0.26	0.415	41.5%
FA	0.15	0.21	0.37	0.37	0.26	0.270	27%
TRA	0.15	0.07	0.12	0.12	0.22	0.137	13.7%
FEA	0.15	0.07	0.12	0.12	0.22	0.137	13.7%
PRM	0.08	0.03	0.02	0.02	0.04	0.041	4.1%
	CR value: 0.08 < 0.10 (consistent)						

Key: **QHRR** = Qualified Human Resource Ratios; **FA** = Funding Availability; **TRA** = Technical Resources Availability; **FEA** = Facilities and Equipment Availability; **PRM** = Periodic Review and Maintenance

Table 7-10 Training Performance Indicators

Training PIs	CT	MHCA	NTCI	RATP	TMI	TE	TCS	VAIST	FE	Priority Vector	Relative Weights %
CT	0.19	0.17	0.17	0.22	0.16	0.16	0.38	0.15	0.16	0.198	19.8%
MHCA	0.05	0.04	0.01	0.05	0.04	0.04	0.10	0.12	0.04	0.054	5.4%
NTCI	0.05	0.17	0.04	0.05	0.04	0.04	0.02	0.04	0.04	0.056	5.6%
RATP	0.05	0.04	0.04	0.05	0.04	0.05	0.10	0.12	0.05	0.061	6.1%
TMI	0.19	0.17	0.17	0.22	0.16	0.16	0.10	0.12	0.16	0.162	16.2%
TE	0.19	0.17	0.17	0.16	0.16	0.16	0.10	0.12	0.16	0.155	15.5%
TCS	0.05	0.04	0.17	0.05	0.16	0.16	0.10	0.15	0.16	0.117	11.7%
VAIST	0.05	0.01	0.04	0.02	0.05	0.05	0.02	0.04	0.04	0.037	3.7%
FE	0.19	0.17	0.17	0.16	0.16	0.16	0.10	0.15	0.16	0.160	16%
										CR value: 0.07 < 0.10 (consistent)	

Key: **CT** = Continuous Training; **MHCA** = Multi-hazard Capacity Assessment; **NTCI** = Number of Training Courses Implemented; **RATP** = Ratio of Accredited Training Programmes; **TMI** = Training Modes Implemented; **TE** = Training Evaluation; **TCS** = Training and Capacity Standards; **VAIST** = Use of Virtual, AI and simulation technologies; **FE** = Frequency and types of exercises

7.3.10 Training Performance Indicators

Table 7-10 shows the ranking of the pairwise comparisons for the nine performance indicators for training. Continuous training had the highest weight of 19.8% while use of virtual, AI and simulation technologies had the least priority of 3.7%. Training modes implemented, frequency and types of exercises and training evaluation all ranked in the middle with weights of 16.2%, 16.0% and 15.5% respectively.

7.3.11 Coordination Performance Indicators

Table 7-11 shows a pairwise comparison of the six performance indicators for coordination. Equipped operations centres were considered by participants to be the most important performance indicator with a priority weight of 24.1%, followed by crisis appropriate operational protocols and information exchange mechanisms with priorities of 21.3% and 18.1% respectively. Public and community coordination mechanisms were considered the least important with a weight of 7.6%.

Table 7-11 Coordination Performance Indicators

Coordination PIs	EOC	PCCM	IACM	DRR	CAOP	IEM	Priority Vector	Relative Weights %
EOC	0.22	0.27	0.17	0.39	0.21	0.19	0.241	24.1%
PCCM	0.06	0.07	0.17	0.03	0.07	0.06	0.076	7.6%
IACM	0.22	0.07	0.17	0.10	0.21	0.19	0.159	15.9%
DRR	0.06	0.20	0.17	0.10	0.07	0.19	0.130	13%
CAOP	0.22	0.20	0.17	0.29	0.21	0.19	0.213	21.3%
IEM	0.22	0.20	0.17	0.10	0.21	0.19	0.181	18.1%
							CR value: 0.07 < 0.10 (consistent)	

Key: **EOC** = Equipped Operations Centres; **PCCM** = Public & Community Coordination Mechanisms; **IACM** = Inter-agency Coordination Mechanisms; **DRR** = Defined Roles & Responsibilities; **CAOP** = Crisis Appropriate Operational Protocols; **IEM** = Information Exchange Mechanisms

7.3.12 Information Management and Communication Performance Indicators

Seven performance indicators for information management and communication were subject to pairwise comparison as shown in Table 7-12. Respondents considered communication time to response teams as the most important indicator attributing a weight of 42.8%, the highest priority accorded to any performance indicator. Trained media response units were considered the least important reflected in a weight of 3.1%. Participants assigned mid-level priority to number of information and reporting

mechanisms, smart application use in incident reporting, and multilingual communication mechanisms with weights of 15.2% and equal weights of 12.1% respectively.

Table 7-12 Information Management & Communications Performance Indicators

Info Mgt & Comms PIs	CTFIR	SAU	MLC	NIRM	DCM	TMRU	PIPI	Priority Vector	Relative Weights %
CTFIR	0.47	0.53	0.53	0.57	0.27	0.21	0.42	0.428	42.8%
SAU	0.09	0.11	0.11	0.11	0.22	0.14	0.07	0.121	12.1%
MLC	0.09	0.11	0.11	0.11	0.22	0.14	0.07	0.121	12.1%
NIRM	0.09	0.11	0.11	0.11	0.16	0.21	0.28	0.152	15.2%
DCM	0.09	0.03	0.03	0.04	0.05	0.14	0.07	0.064	6.4%
TMRU	0.08	0.03	0.03	0.02	0.01	0.03	0.02	0.031	3.1%
PIPI	0.08	0.11	0.11	0.03	0.05	0.14	0.07	0.083	8.3%
	CR value: 0.09 < 0.10 (consistent)								

Key: **CTFIR** = Communication time to response teams following incident report**; SAU** = Smart Application Use in Incident Reporting**; MLC** = Multilingual Communication Mechanisms**; NIRM** = Number of Information & Reporting Mechanisms**; DCM =** Data Collection Mechanisms; **TMRU -** Trained Media Response Units; **PIPI =** Public Information Programmes Implemented

7.3.13 Risk and Hazard Management Performance Indicators

Table 7-13 shows that of the five performance indicators for Risk and Hazard Management continuous hazard and risk monitoring ranked highest with a weight of 28.8% while frequency risk register reviewed attracted the lowest priority of 4.9%. All hazards risk register and risk communication plan ranked second and third with weights of 26% and 23.9% respectively.

Table 7-13 Risk and Hazard Management Performance Indicators

Risk and Hazard Assessment PIs	AHRR	FRRR	RCC	PSR	CHRM	Priority Vector	Relative Weights %
AHRR	0.27	0.14	0.24	0.37	0.29	0.260	26%
FRRR	0.09	0.05	0.04	0.02	0.05	0.049	4.9%
RCC	0.27	0.27	0.24	0.12	0.29	0.239	23.9%
PSR	0.09	0.27	0.24	0.12	0.10	0.164	16.4%
CHRM	0.27	0.27	0.24	0.37	0.29	0.288	28.8%
	CR value: 0.08 < 0.10 (consistent)						

Key: **AHRR** = All Hazards Risk Register; **FRRR** = Frequency Risk Register Reviewed; **RCC** = Risk Communication Plan; **PSR** = Plans for Specific Risks; **CHRM** = Continuous Hazard and Risk Monitoring

7.4 Evaluation of Consistency of AHP Results

Evaluation of the reliability of the AHP results requires a certain level of consistency in the matrix comparisons in respect of judgements of the criterion in relation to each other. Inconsistencies can reflect either measurement error related to the way in which participants' preferences are elicited such as ambiguity in the dimensions of the items compared, or issues inherent to the participant's decision-making such as uncertainty in preferences as a result of inadequate information (Dadkhah and Zahedi, 1993). The process of evaluating consistency and whether this is satisfactory is determined in AHP through calculating a Consistency Ratio (CR). This is derived from the ratio of the Consistency Index (CI), an index of the consistency of judgements across all pairwise comparisons (Lootsma, 1991), to the Random Index (RI) which is the CI of a matrix of randomly generated comparisons (Mu and Pereyra-Rojas, 2017). According to the literature a CR of 0.10 or less is acceptable to continue with the AHP analysis (Saaty et al., 2007; De Felice et al., 2016). Random pairwise comparisons were simulated to generate average random indices for different-sized matrices. The RI for each criterion is provided in Table 7-14.

Table 7-14 Random Index

n	1	2	3	4	5	6	7	8	9	10
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.48

Where *n* = number of criteria

A key measure of validity in an AHP process is the use of expert opinion, which has been proposed to compensate for the use of small sample sizes generally characteristic of the AHP. Small sample sizes are therefore considered more acceptable than in the case of other quantitative methods such as surveys (Saaty, 1990; Cheng and Li, 2001; Drake et al., 2013). In this study the data was collected from participants from a cross-section of public sector directorates and command authorities at federal and local level that have key roles and responsibilities for road traffic crisis readiness and response. The selected participants possessed at least ten years of experience within emergency and crisis response and additionally had operational and strategic knowledge of crisis response practices, and were closely involved in strategic and operational decision-making processes.

7.5 Conclusion

This chapter presented the results of an AHP framework to identify, prioritise and select criteria, sub criteria and performance indicators critical for improving crisis readiness and response times. The results from Round 3 of the Delphi Panel were subject to Analytical Hierarchy Process to prioritise the different criteria, subcriteria and key performance indicators evaluated as most important for optimising road traffic response times. The initial sections of this chapter provide an overview of the analytic procedures followed and the validity and reliability of the AHP results. The final sections present the findings validating the final strategic framework for improving road traffic crisis response times. In the following chapter, these findings are discussed in relation to the literature and previous studies.

CHAPTER 8: DISCUSSION OF FINDINGS

8.1 Introduction

This chapter presents a salient discussion of the findings generated through the whole of the research process. This represents a synthesis of both theoretical and the primary research generated and discussion of the significance and implications of the findings relative to the broader body of knowledge and practical field. Notably this chapter triangulates and synergises all the data generated from the literature review and the primary research in relation to the research questions of this study. This discussion draws on three key sources of data: a review of the literature, secondary data analysis of crisis readiness practices; and Delphi panel producing qualitative and quantitative data.

This research investigated crisis readiness and response of police in the UAE to develop a strategic framework that supports readiness and response planning to improve police response times to road traffic crises. This goal guides the discussion in this chapter which is structured according to the five research questions:

1. What are the existing strategies and practices for crisis readiness and response for Police in the UAE?
2. What are the barriers that obstruct the development and implementation of UAE's performance indicators, focused on law enforcement participation within UAE road crises situations?
3. What factors and elements of crisis readiness based on theory and praxis are critical for the specific context of improving response times to road traffic crisis in the UAE?
4. What are the perspectives of practitioners of crisis readiness of the police and how do they prioritise and weight the different strategic factors and performance indicators?
5. What strategic framework can be proposed that will enable the development of strategies and performance indicators to enhance response times of police to road traffic crises?

The findings are specific to an Arab context and the culture of the UAE, and the priorities for crisis readiness and response and the challenges identified emerge from within this specific context.

8.2 Crisis Response in the UAE

The first objective of this study was to evaluate road traffic crisis readiness and response strategies of the police in the UAE. A review of secondary data and qualitative interviews during the Delphi process identified the key characteristics of crisis response in the UAE. There is recognition of and senior level commitment to increasing the ability of the police to respond in an increasingly integrated approach that addresses multiple dimensions and engages with a broad range of actors from across the crisis community. Firstly, organisational data and interviewee respondents indicated major focus on addressing a key performance indicator in terms of response times that is viewed as the primary measure and benchmark for evaluating the effectiveness of crisis response of the police. International comparisons showed that average response in the UAE was significantly higher than other countries. While there has been some improvement since 2016 the existing level of response is still higher than global best practice. Broader evaluation of the crisis response components and processes has been recognised as critical to enhancing the responsiveness of police to road traffic crises. At national strategic level it is evident that the UAE has developed key strategies, objectives, planning, structures, roles and responsibilities at all levels of crisis response in the UAE. However, in the UAE recent responses to crises revealed that effective coordination is hampered by an absence of appropriate policies and mechanisms and understanding of how coordination can be optimised (Alteneiji, 2015). In particular the degree of coordination between federal and local levels during the management of disasters has been called into question (Alteneiji, 2015; Al-Marzooqi et al., 2017; Almarzouqi, 2017).

The key strength of the existing framework is in the area of national disasters where the UAE has been highly proactive in building its capacity and defining key roles. The National Emergency, Crises and Disasters Management Authority (NCEMA) has mandated responsibility for multiple roles: oversight of national response capabilities and coordination of inter-agency co-ordination at state and local level. Crisis response strategies at all levels are framed around the National Response Framework (NRF) which

defines crisis management standards based on key principles of: comprehensive approach; legal force; all hazards and scenarios; definition of roles and responsibilities. Notably, the UAE has developed its approach by integrating emergency management standards from international and national frameworks including the UK and Australia.

A second objective of this research is to identify the barriers that impact on the role of law enforcement agencies within traffic crisis situations. In assessing the UAE's existing approaches a number of performance issues and barriers become evident. Firstly, the lack of integration at the federal level which can be characterised as highly decentralised by region and detached from the police force in other Emirates. Each Emirate has a dedicated regional crisis and disaster management team, headed by the high commander of the local police force, and technologies and systems. In respect of crisis management during disasters some overlap has been noted in relation to how prevention, preparedness and recovery efforts are coordinated with the police force which clearly assume a central role in leading responses and managing crises and disasters. Duplication of roles, communication gaps, and speed of response are identified as key issues (Al-Marzooqi et al., 2017). Greater optimisation in this area could positively influence the adoption of a more holistic approach to crisis readiness and response that links international, regional, national and local level initiatives to enhance preparedness (UN, 2008).

Further, the comprehensive application of the National Response Framework to all stages of the emergency crisis management cycle diverges from practice in developed countries (Alteneiji, 2015). Frequently separate frameworks or planning approaches for each element of the cycle of mitigation, preparedness, response and recovery are formulated to address varying needs (Henstra, 2010; Alexander, 2015; ; Alteneiji, 2015). Moreover the crisis management standards in countries such as the US incorporate all the frameworks within the preparedness phase (FEMA, 2015). At operational level performance issues have been noted in terms of interoperability, language barriers, resources, organisational culture and clandestineness and power. There is a lack of standardisation and capabilities for knowledge sharing and communications across all control room processes (MoI, 2017). In terms of engagement the approach in the UAE focuses on a narrow group of direct response organisations and partners and limited community or public collaboration. While the UAE has placed increasing priority on

addressing crisis readiness and response overall the level of maturity of strategies and policies and procedures is low. Key areas of crisis readiness remain to be optimised and the framework evidences gaps and underutilisation of key elements and dimensions that theory and practice shows are critical to crisis readiness.

8.3 Ranking of Crisis Readiness Criteria and Subcriteria

The first round of the Delphi process involved the completion of an unstructured online questionnaire to obtain qualitative data from participants about subcriteria and key performance indicators. Responses were thematically analysed and informed the second round. Section 5.3 presents the results for round two generated from the second semi-structured questionnaire which integrated all the subcriteria and measures generated from the first round.

Quantitative analysis and thematic analysis of the qualitative data was conducted to determine the rationale and justification for the rating and priority given to key elements. The results from Round 3 of the Analytical Hierarchy Process present criteria, subcriteria and key performance indicators evaluated as most important for optimising road traffic response times. The final section of this chapter presents the findings validating the final strategic framework for improving road traffic crisis response times.

8.3.1 Top Level Criteria

The findings resulted in the ranking of the ten criteria that were identified for crisis readiness and response. These were categorised into top level, mid-level and low level criteria based on their relative weightings and the closeness of their groupings. The top level criteria ranged between 17.3%-14.1%, the mid-level criteria between 11.4%-9.6%, and the low level criteria 5.6%-2.6%. Four criteria of Response Planning, Resources, Training, and Coordination were assigned the highest importance by practitioners. The AHP priority weightings for these four criteria were in a narrow range suggesting these were viewed equal in significance. Thus the findings do not establish clearly the relative importance of these four criteria due to the marginal differences in the priorities assigned overall. Even so the priority attached to these four criteria by the Delphi panel align with the key components of crisis readiness frameworks distinguished in the literature. These

components consistently formed part of all of the frameworks reviewed in the literature review chapter (FEMA, 2001; Sutton and Tierney, 2006; IASC, 2013; WHO, 2017).

8.3.1.1 Response Planning

Response planning was the mostly highly ranked criterion overall but was only marginally prioritised over the other three top ranked criteria. The primary significance attached to response planning in this study supports the consensus in the literature and practice on the importance of this dimension. While the majority of crisis readiness frameworks do not explicitly prioritise this criterion over others, all frameworks incorporate response planning as a core dimension (FEMA, 2001; Sutton and Tierney, 2006; IASC, 2013; WHO, 2017). The literature endorses this criterion as an indispensable element for effective response to immediate crisis impacts and maintaining business continuity and long-term recovery (Alexander, 2015; WHO, 2017).

One of the challenges acknowledged in the literature is the complexity in establishing flexible and responsive models. Evidence shows that overly prescriptive response plans can result in diminished ability to integrate situational factors and other contingencies during a crisis thus undermining response effectiveness (Quarantelli, 1998; Berchtold et al., 2020). Dynamic response models imply consideration of organisational structures from hierarchical structures to more decentralised governance that allows for greater autonomy and discretion for organisations, teams, and individuals. This can be more challenging for countries such as the UAE where the national culture is characterised by high power distance and uncertainty avoidance (Hofstede, 2019). In such contexts developing highly flexible response planning requires a major cultural change in a culture where subordinates expect to be directed and controlled by superiors (Hofstede, 2019). The literature underlines the importance of autonomy and discretion for response planning and the impact of rigid structures. Evidence suggests a negative relationship between linear, command and control structures and response planning, and coordination failures as a result of the tendency to ignore the complexity and chaotic conditions inherent in crises (Tierney, 2003; Corbacioglu and Kapucu, 2005; Ginter et al., 2006). Unlu et al., (2010) revealed that the centralised, hierarchical structure characteristic of the Turkish crisis management system weakened the flexibility to respond to different local crises.

The emphasis attached to broad collaboration of the response community implies further complexity in achieving flexible inter-organisational governance mechanisms. Much of the crisis readiness literature defines guidelines and detailed protocols and processes for the conduct of response planning, and proposes standards and principles that prescribe the nature of response planning and shape the development of response planning capabilities (FEMA, 2001; Sutton and Tierney, 2006; Boin, 2010; WHO, 2017). However, there is lack of attention in understanding inter-organisational dimensions of response planning to address structures, roles and integration of resources and capacities.

8.3.1.2 Resources

Results showed that the remaining three of the top four criteria were prioritised at comparable levels by panel members. Resources ranked as the second most important criterion for enhancing crisis response times. There is consistency in the literature and responses of the Delphi panel in the study of the relationship between resources and response planning. This finding supports the literature which consistently identifies the availability and management of resources as one of the most essential elements of crisis readiness and response. Resources feature as a key constituent in all crisis readiness frameworks with the majority identifying multiple dimensions and processes as significant (FEMA, 2001; Sutton and Tierney, 2006; IASC, 2013; WHO, 2017). Moreover considerable definition and detail is provided in the literature that describes the character and identifies the importance of the availability and accessibility of resources both to develop a state of crisis readiness and to support allocation and deployment of response teams (Gomez and Turoff, 2007; Light and Morgan, 2008; Zemp, 2010). In the context of road crisis traffic response the EU (2018) places major priority on resources for directly influencing the ability of agencies to effectively respond.

Within this field and many areas resourcing consistently emerges as a major constraint, often viewed in generic terms or based on simplified classifications. At one level this emphasises the importance of political and organisational commitment to ensure necessary levels of resourcing. The competition for scarce resources across all sectors of government creates significant challenges. This issue can be lessened by emphasis on innovative approaches which facilitate mobility and efficiency resourcing. This implies strategies for integration, reducing redundancy and maximising resource-sharing based on more complex analyses. This perspective is consistent, as the contemporary literature

identifies resources to be a complex, interdependent and multi-faceted dimension in crisis response associated with a range of different issues and factors (Simonoff et al., 2011; Hick et al., 2012; Wang and Sun, 2018). Much emphasis has been placed on a multi-objective approach that ensures the efficient, fair and timely allocation of scarce resources that can account for specific crises and conditions (Alsubaie et al., 2015; Choksi and Zaveri, 2019). This in turn is linked to the importance of knowledge of the availability of different and specialist resources across crisis response organisations to match capabilities, capacities and needs (Berchtold et al., 2017). Evidence suggests that efficient resource allocation practice is increasingly evolving towards in-time and real-time techniques based on technology solutions such as RFID tagging, virtual simulation and resource management algorithms that prioritise and schedule resources (Choksi and Zaveri, 2019). These issues generate multiple implications for resourcing crisis response organisations in terms of creating effective systems and structures that maximise the transparency and utilisation of available resources, and facilitating information flows, data communication and data collection. This calls for identification of antecedents including cultural such as power that may influence co-operation inter-organisationally to promote optimisation and sharing of resources.

8.3.1.3 Training

Panel members prioritised training as the third most important criterion for crisis readiness. The relatively high priority accorded to this criterion broadly supports the degree of importance identified in the literature. The literature underlines crisis readiness training as a key issue that directly impacts the ability of crisis response organisations to mount an effective response (Bui and Subba, 2009; Hošková-Mayerová, 2016). Training is cited in all of the crisis readiness frameworks reviewed for this study, although only the FEMA (2001) and IASC (2013) framework explicitly identify this criterion as a separate, discrete aspect. In the broader literature there is a significant focus on the role of training in crisis readiness and it discusses and describes the associated approaches, elements, standards and competencies (Alexander, 2002; Perry and Lindell, 2003; Parker et al., 2005; Hart and Sundelius, 2013; Feldmann-Jensen et al., 2017). Training is also identified as a core element in many national level plans and in multiple sectors and has been highlighted as a critical success factor for managing effective trans-boundary crisis response (Berchtold et al., 2017).

The challenge in addressing this aspect of crisis response firstly lies in defining key roles, structures and processes. Training design is shown to be a complex process that must take into account diverse and specific training needs across an array of functions, roles and levels as well as intra and inter-organisational contexts and requirements (Leaning et al., 2013; Adini et al., 2016). As a result training programmes and exercises can be expected to fulfil multiple, and often conflicting, goals and priorities simultaneously (Jackson and McKay, 2011). Notably the design of training programmes is contingent firstly on widespread agreement on the roles and responsibilities of different agencies and identifying shared and cross-cutting themes. This implies some form of strategic analysis and development of shared understanding and goals between agencies. Evidence shows for example that while operational and tactical training is well established, gaps exist in training at strategic crisis management level and for novel or out-of-scale events (Owen et al., 2016). These issues have an implication for the assessment and evaluation of the effectiveness of training that can support the optimisation of training design across the entire crisis response community. Literature shows however that evaluation is frequently lacking and is in turn subject to numerous factors that can challenge or undermine the ability to assess training programmes for shortfalls and outcomes (Hsu et al., 2013; Adini et al., 2016). Methodologies have yet to be developed that can effectively assess if a particular response system will perform well based on its training and preparedness (Jackson and McKay, 2011).

8.3.1.4 Co-ordination

Co-ordination was the fourth highest prioritised criterion and comparable to training. This is consistent with the literature, which characterises coordination as one of the principal elements directly connected to crisis readiness and crisis management during response and relief processes (Chen et al., 2008; Abbasi et al., 2013; Noori et al., 2016). While this criterion is reflected in the literature as a core element of crisis readiness, the extent to which it is addressed in different frameworks varies considerably (FEMA, 2001; Sutton and Tierney, 2006; IASC, 2013; WHO, 2017). The Common Framework for Preparedness of the WHO (2017) and the Strategic Framework for Emergency Preparedness (IASC, 2013) refer to coordination mechanisms among multiple actors across different levels and emphasise strategic vision but fall short of operationalising co-ordination mechanisms and procedures.

Achieving effective co-ordination between agencies represents a critical factor that establishes flow of information, communications and co-operation that is necessary in order to develop response plans, resources and training. This is highlighted as a major challenge in the literature in managing the tension between organising for coordination and necessary flexibility (Boin, 2010; Christensen et al., 2015). The design of co-ordination mechanisms is dependent on overcoming differences in the organisational culture and therefore understanding of key barriers and impediments. A significant theme identified in the literature is the multiplicity and diversity of public administration and coordination structures which are influenced by different national and governance contexts, and often result in a range of hybrid and contradictory coordination arrangements (Christensen et al., 2015; Christensen et al., 2016).

Arabic organisations are characterised by aspects of clandestineness, power dynamics, secrecy and closed, top-down cultures (Seba et al., 2012; Al-Esia and Skok, 2014) which may create challenges for the development of co-ordination. Enhancing effective co-ordination for crisis readiness therefore has some implication for addressing cultural issues. Harmonising competing interests and contending with ambiguity in public structures is emphasised to require adaptability and flexibility to ensure effective vertical and horizontal coordination (Christensen et al., 2016). Compounding this issue attention is drawn to the fragmentation of authority inherent to crises and disasters, where the problems caused by the crisis rarely fall within the domain of just one agency and are infrequently coordinated in a linear, comprehensive manner (Boin, 2010). According to Boin (2010) there is a key implication in terms of the dependency of effective response on factors such as prior interaction and trust between agencies, teams and individuals.

8.3.2 Subcriteria for Top Level Criteria

A third objective of this study is concerned with identification of the factors and elements of crisis readiness for the specific context of improving response times to road traffic crisis in the UAE. A review of the literature identified sixteen separate criteria and a range of subcriteria and indicators that informed the conceptual framework for this study and which were subsequently presented to a Delphi panel for evaluation. The qualitative and quantitative research conducted in this study provided primary data to identify and validate the key dimensions for crisis readiness.

The perspectives of police crisis readiness practitioners were gathered to identify how they prioritise and weight the different subcriteria and key performance indicators for enhancing crisis readiness and response. Use of a Delphi method provided an iterative convergence of opinion on the relative importance of the different elements. The AHP analysis provided a statistical and systematic decision technique that supported identification and prioritisation of the criteria, subcriteria and indicators. The weightings from the AHP analysis were aggregated to produce results based on the averaged scores.

8.3.2.1 Response Planning Sub criteria

Of the four subcriteria associated with the response planning criteria, findings show that joint planning and resource planning were prioritised equally and by a significant margin over other subcriteria. These results validated the priority attached in the literature where joint planning and resource planning were identified as enablers for long-term development of crisis preparedness capabilities and progression towards shared objectives (Sutton and Tierney, 2006; IASC, 2013; WHO, 2017; UIC, 2017).

A key principle of joint planning is the engagement of actors and inter-organisational collaboration (FEMA, 2001; WHO, 2017) which the literature suggests as an embedded process at multiple different levels: national, regional, and local (FEMA, 2001; CCA, 2004; Grieb and Clark, 2008; Medford-Davis and Kapur, 2014). In respect of resource planning, the findings from this study diverge from the literature in explicitly identifying resource planning as a top-level factor for response planning. Existing frameworks and guidance provide a fragmented discussion of this relationship. The Strategic Framework for Emergency Preparedness (SFEP) (WHO, 2017) makes no reference to resource planning as a component of response planning. The IASC (2013) Common Framework for Preparedness (CFP) framework and Disaster Preparedness research by Sutton and Tierney (2006) identify resource planning as a factor of response planning with the main focus on the development of resource agreements among partners. Sutton and Tierney (2006) identify the importance of mutual aid and resource-sharing agreements as a component of formal and informal response planning. The IASC (2013) further suggests the development of resource and supply agreements to address different contingencies at national, regional and international level. The FEMA (2001) Capability Assessment for Readiness framework (CAR) emphasises the establishment of a resource management function at state level that undertakes planning for resource management issues that is

maintained as a state emergency plan. Specific elements are outlined of designation of a resource coordinator, resource inventories, operational controls, notification and activation procedures and processes and the formation of an industry resource council. Thus while the results of this study emphasise resource planning as a key component of response planning the literature has yet to establish consensus on the key elements. Within the broader literature on crisis management resource planning appears to attract greater attention (Rauner et al., 2012; Liu et al., 2013; Schryen et al., 2015). Some studies propose resource planning elements to serve as criteria or indicators to evaluate crisis management strategies or as indicators in simulations in response (Dihe et al., 2013; Engelbach et al., 2014).

The establishment of roles and responsibilities was a further factor which was prioritised moderately relative to the other subcriteria of response planning. Within the literature this is identified as a key factor that forms part of all frameworks and extends to a wide variety of actors and stakeholders at local, regional and national level (FEMA, 2001; Sutton and Tierney, 2006; IASC, 2013; WHO, 2017).

Regular review and update was assigned the lowest priority weighting of all of the subcriteria. This finding reflects the general pattern found in the literature where this aspect is not discussed as frequently or comprehensively as other response planning elements. None of the frameworks reviewed identify the importance of regularly reviewing and updating response plans (FEMA, 2001; Sutton and Tierney, 2006; IASC, 2013; WHO, 2017). Perry and Lindell (2003) provide a possible explanation for the lower relative priority, arguing that the updating process is both resource and time consuming and if undertaken too frequently can divert energy from other activities. It may well be that the evaluation process is viewed by the Delphi panel as forming part of the wider organisational system. This should be examined to determine the degree to which evaluation processes address all the specific aspects of response planning.

8.3.2.2 Resource Subcriteria

Of the six subcriteria assessed under the Resources criterion three subcriteria were equally assigned the highest priority: human resources, physical resources and logistics and facilities. The majority all of the reviewed frameworks specifically refer to all three resource categories and outline the key elements (FEMA, 2001; Sutton and Tierney,

2006; WHO, 2017). Thus the findings lend support for the operationalisation of these resource subcriteria in equal measure and that is reflected in the literature (Kapur and Smith, 2010; Farazmand, 2017). Three frameworks specifically refer to all three resource categories as key components of resources overall and provide key details on the necessary elements (FEMA, 2001; Sutton and Tierney, 2006; WHO, 2017). There is a strong focus on financial resources in the CFP framework (IASC, 2013) and WHO (2017) in terms of availability and access to budgets and emergency contingency funds and contingency funding mechanisms. Training reflects a resource factor in the literature which defines a wide range of elements: dedicated, trained and equipped human resources; recruitment, all-hazards training for frontline responders; establishment of a training programme, and creation and maintenance of specialised teams (Sutton and Tierney, 2006; FEMA, 2012).

In terms of physical resources and logistics the literature emphasises different components to varying degrees. Sutton and Tierney (2006) simply refer to developing logistics capabilities under the resources dimension, while WHO (2017) focuses on logistics mechanisms that ensure access and availability to emergency supplies and equipment and include cross-sector systems and agreements for logistical capacities. Only one framework by Sutton and Tierney (2006) mentions technological resources as a component of resources while the broader literature discusses technological resources in terms of informational sources of support and technologies to support crisis relevant tasks such as public warning. While the findings in this study validate the importance of different resource subcriteria, it is evident that resourcing reflects a multi-faceted dimension that must be considered in terms of the factors relevant to specific crisis contexts. Further, response plans and identification of risks and hazards would interact with the resources criterion in shaping and prioritising resource requirements.

Two other subcriteria were assigned a lower rating: Advanced Technological Resources and Maintenance of Logistics Systems were weighted similarly and moderately in comparison. The lower priority given to advanced technological resources is somewhat consistent with the literature which attaches less emphasis to this aspect than other elements. Three of the four frameworks do not explicitly identify technological resources, while contrastingly specifying other resource dimensions such as human or

physical (FEMA, 2001; IASC, 2013; WHO, 2017). Evidently these findings attach less significance to the role of technology relative to the other resource subcriteria. This may well be influenced by the level of technology maturity or technological capabilities, knowledge and awareness of the Delphi panel members in this study. Research has explored the role and importance of technological resources and technological infrastructure within crisis readiness (Gomez and Turoff, 2007; Bui and Subba, 2009; Yates and Paquette, 2011). Logistics planning was assigned the lowest priority for all Resources subcriteria. This accords with Berchtold et al., (2017) who explains that logistics and their planning and provision do not play a significant role for many crisis management organisations as basic services and logistics are generally available.

8.3.2.3 Training Subcriteria

Pairwise comparison of the ten Training subcriteria showed that prioritisation was relatively evenly distributed across the majority. However two subcriteria of continuous leadership development and field training were assigned a higher level of importance than any others.

The priority accorded to leadership development is inconsistent with the literature where this aspect does not emerge as more critical than any other training need. None of the frameworks reviewed identify leadership training as a key component of training for crisis readiness and response or outline its primary elements or characteristics. On the other hand this pattern is not replicated within the wider literature in which crisis leadership development and its critical components and attributes have attracted a moderate body of guidance and research (Wooten and James, 2008; Kapucu, 2011; Nesse, 2017).

The importance placed on field training supports the literature as considerable priority is afforded to this variable as a core training practice. All of the reviewed frameworks specify the provision of training that is practically based and outside of the classroom (FEMA, 2001; Sutton and Tierney, 2006; IASC, 2013; WHO, 2017). Some research proposes field training exercises as vital elements of an overall training framework that ensures comprehensive practice for mounting responses on the ground (Aitken et al., 2011; Tanimura and Yoshikawa, 2014).

Five subcriteria were similarly prioritised as of more moderate significance. The most important factor in this group is exercises, followed by technical training, equipment training, theoretical training and inter-agency exercises. Some research proposes field training exercises as vital elements of an overall training framework that ensures comprehensive practice for mounting responses on the ground (Aitken et al., 2011; Tanimura and Yoshikawa, 2014). The moderate weighting accorded to exercises contrasts strongly with the literature which prioritises this factor as a critical part of crisis readiness training and development. Nearly all of the reviewed frameworks explicitly identify exercises either as a standalone criterion for crisis readiness and response or a fundamental element of training (Sutton and Tierney, 2006; IASC, 2013; WHO, 2017). Meanwhile a body of literature has investigated and identified the role of exercises and how they can be improved across a range of different settings and sectors (Sinclair et al., 2012; Kim, 2013; Skryabina et al., 2017). The EU characterises limited ability to learn from exercises as a major failure factor in crisis management (Berchtold et al., 2017).

The remaining three subcriteria of virtual simulations, database of resources and capacities and adoption/benchmarking of best practice received much lower priority weights. This may well be influenced by the emphasis placed by panel members on practical exercises over technological solutions or their experience and understanding of the potential. Within the wider literature such subcriteria are regarded as key training measures. The Common Framework for Preparedness (IASC, 2013) and the Disaster preparedness (DP) model by Sutton and Tierney (2006) propose field and practical training in terms of simulations and drills, encompassing the presence of local, national and / or international actors.

8.3.2.4 Co-ordination Subcriteria

The relative importance of six subcriteria were compared for the Coordination criteria. Findings showed that two subcriteria of Operational Planning and Coordinated Operational Procedures were the most highly prioritised for effective coordination, and by a significant margin over the remaining subcriteria.

This aligns strongly with the literature where development of operational and procedural mechanisms are explicitly cited in most of the frameworks reviewed (Sutton and Tierney, 2006; IASC, 2013; WHO, 2017) and the broader literature (Bui and Subba,

2009; Henstra, 2010; Liapis et al., 2015). There is less focus in the literature on operational planning as a distinct dimension which is cited only in the Disaster Preparedness model (Sutton and Tierney, 2006). The result from this study implies the formation of a distinct operational planning function separate from other planning processes. According to Sutton and Tierney (2006) this implies a framework for operational planning that incorporates preparedness committees and networks and developing common understanding of roles and responsibilities.

Inter-agency Coordination was the third most prioritised factor for overall co-ordination. All four frameworks explicitly identify inter-agency collaboration and working as a key characteristic of coordination and some identify the main actors and processes (FEMA, 2001; Sutton and Tierney, 2006; IASC, 2013; WHO, 2017). Wider research and practice have consistently suggested the importance of and explored the elements of effective inter-agency collaboration at multiple different levels (Bui and Subba, 2009; Kapucu, 2009). Identified as a critical success factor, Piotrowski (2010) examines the role it has played in unsuccessful responses to actual crises. The importance of joint training lends further support to inter-organisational agency co-ordination.

The remaining two subcriteria of Centralised Coordination Systems and Public Coordination were not prioritised to the same degree as any of the other subcriteria. This may well be associated with the national and organisational culture dimensions as Arabic cultures are characterised by clandestine and closed cultures and power distance. Thus centralisation may reflect a loss of organisational power and control that different agencies may be unwilling to relinquish, either to other organisations or to the wider public. Thus there is a major implication to explore cultural antecedents to identify the barriers and enablers to centralised systems and public engagement.

8.3.3 Mid-Level Criteria

The Delphi panel assigned mid-level priority to Information Management and Communication and Risk and Hazard Management relative to the other criteria. Both these subcriteria were rated equally in terms of their importance.

8.3.3.1 Information Management and Communication Criteria

Information Management and Communication (ICM) was ranked moderately in priority and was the fifth most important criteria for crisis readiness. This factor was

identified as a key component of all the crisis readiness frameworks reviewed. The literature consistently shows consensus on the importance of rapid and accurate information gathering and dissemination to relevant actors and the public to mitigate the worst effects of crises and disasters (OCHA, 2002; Sokat et al., 2016).

The IASC (2013) Common Framework specifically identifies information management and communication as a distinct factor. The design of ICM implies consideration of a wide range of factors and issues associated with the effectiveness of knowledge sharing and communications; systems design, social media, networked technologies, communication actors and stakeholders, enablers and success factors, and communication structures (Tanner et al., 2009; Lee et al., 2017).

Much emphasis is placed in research and practice on the underpinning role of information and communication in the effective implementation of other crisis response criteria. Information is consistently characterised as the critical element in the post-crisis damage and needs assessment process, and the basis for the mobilisation of resources and for cohesive coordination and decision-making during crisis events (Bahadori, 2015; PAHO, 2019). In the area of risk and hazard management, risk communication and information collection and analysis are considered integral to the entire risk management lifecycle (FEMA, 2015; WHO, 2019). A key theme to emerge across all these dimensions is the significance of interorganisational communication and knowledge sharing that makes the right information accessible to all relevant actors at the right time (PAHO, 2019; WHO, 2019). Despite its importance, organisational and cultural factors have been identified that may represent barriers to inter-organisational information sharing in the Arab and UAE contexts. Research shows that power differentials and hierarchy are characteristic of the Arab workplace and influences a tendency towards secrecy and sharing information primarily for personal advantage only (Seba et al., 2012; Al-Esia and Skok, 2014). Moreover, in a society in which religion, tribal and family ties remain a powerful driver for attitudes and behaviour, evidence has consistently identified the centrality and significance of trustful relationships for knowledge sharing to occur (Ahmad and Daghfous, 2010; Seba et al., 2012; Al-Esia and Skok, 2014). These factors have implications for the design of an information management and communication system that connects all crisis response actors and organisations and shares essential

information across different levels as well as linking to all the different dimensions of crisis response.

8.3.3.2 Risk and Hazard Management

Findings showed that Risk and Hazard Management was the sixth highest criterion in terms of priority. While it is less significant relative to the other five dimensions its inclusion is consistent as a major dimension within the crisis management field. The relative importance attached to risk and hazard management may be an indication of the maturity of risk and hazard management within the sector in the UAE. While the importance of this aspect is acknowledged, risk management and assessment is a relatively recent and often ad hoc practice in crisis response and a number of challenges remain (UN, 2014; Skomra, 2017). Furthermore, the relative importance assigned to risk and hazard management may reflect overall national capabilities. The literature suggests that the generation of risk knowledge is critically dependent on national capabilities in science and technology and the availability and sustainability of monitoring networks and research (WMO, 2008).

All the frameworks incorporate this dimension as a discrete element that is highly operationalised, in contrast to some of the more highly prioritised criteria in this study (FEMA, 2001; Sutton and Tierney, 2006; IASC, 2013; WHO, 2017). Moreover practice among major supranational organisations involved in the crisis response field appears to endow risk management with a high level of significance. For example the World Health Organisation's approach to emergency preparedness is fundamentally linked to a risk reduction strategy (WHO, 2007) while risk analysis and monitoring is one of three pillars of the UN's emergency response preparedness approach (UNHCR, 2019). Drennan et al., (2014) provide one of the only academic guides that specifically focuses on risk management as a distinct aspect in relation to crisis management.

Further, the level of maturity and the relative importance attached may influence the extent to which risk and hazard management are viewed as distinct criterion. This distinction is not evident based on the Delphi panel response which may suggest a more generalised view of this criterion. The literature reflects some differences in the way that risk and hazard management are addressed. For instance, FEMA (2001) separates these into two top level criteria: Hazard identification and risk assessment, and hazard

management. Hazard management follows on from the first and is identified in terms of elimination or hazard reduction where possible. Compared to other frameworks, it is the only framework that specifically focuses on the hazard management dimension. Other frameworks focus mainly on risk assessment as the key process or aspect for instance in the WHO (2017) framework which focuses on assessment of risks and capacities for prioritisation. A key attribute is community level risks assessments, and community participation. Within the wider literature, the topic of risk and hazard management is addressed within the context of an overall framework or unified crisis management system (Unlu et al., 2010; Waugh, 2015). This suggests the development of measures that address specific contexts and therefore for road crisis response the implication is the identification of road hazards and risk factors that address the particular conditions in different countries and regions.

8.3.4 Subcriteria for Mid-Level Criteria

8.3.4.1 Information Management and Communication Subcriteria

Eight subcriteria were shortlisted as key components for the Information Management and Communication (ICM) criterion. Findings revealed that two subcriteria were rated as significantly more important than any others: strategies and policies and advanced communication systems. Public education and information, multichannel communications and inter-agency communication were moderately prioritised in relation to the top subcriteria. Meanwhile transfer of best practice, diverse communication forums and multiple incident reporting types attracted equally low ratings.

Advanced communications systems have received varied levels of attention within existing practice and the broader literature. More particularly only two of the four frameworks (CAR and CFP) specifically refer to technological communications systems as a key component of this criterion, and these do not evidence an explicit emphasis on technological sophistication (FEMA, 2001; IASC, 2013). Nevertheless this can be inferred to some extent from the technological attributes identified as necessary for effective communications capabilities. These include sector or cluster information management systems, shared geospatial mapping abilities and advanced data processing (FEMA, 2001; IASC, 2013). Advanced communications systems emerge as a theme within a wider body of literature however discussion is highly fragmented and diverse

across different types of systems, considered at different levels and aimed at varied communication targets and end users (Collins and Kapucu, 2008; Smith and Simpson, 2009; Heinzelman and Waters, 2010). For example Smith and Simpson (2009) identify enhanced communication technologies for effective disaster response in terms of rapidly deployable, all-terrain communication units. Heinzelman and Waters (2010) discuss systems that enable integration of innovative forms of disaster information gathering such as crowdsourcing.

Similarly there is varied treatment of strategies and policies for communication across the crisis readiness literature. With the exception of the SFEP (WHO, 2017), none of the frameworks explicitly refer to the establishment of policies and protocols for crisis communication and information sharing. The SFEP framework predominantly identifies this factor in terms of social mobilisation strategies for emergency preparedness communication however organisational or cross-agency strategies are not addressed (WHO, 2017). This pattern is reflected in the broader literature where a limited focus is evident on the policies, processes and procedures that underpin information management and communication in the crisis context. Some debate has focused on communication and information sharing protocols to increase the flow and speed of information and frequently embedded within wider discussion of crisis communication (Gomez et al., 2006; Gomez, 2008; OECD, 2013).

The moderate importance assigned to public education and information is to some extent reflected in the literature where this aspect is represented to varying degrees. Within the frameworks only the SFEP (WHO, 2017) explicitly refers to the public aspect of communication as a component of the communication criterion, framed as risk communication and awareness for emergency preparedness within communities. However the wider literature demonstrates a significant focus on this factor and presents and explores a range of different antecedents, systems, lessons and frameworks for communicating with the public for effective crisis readiness and response (Collins and Kapucu, 2008; Tanner et al., 2009; Seyedin and Jamali, 2011).

The relatively low significance attached to transfer of best practice in, diverse communication forums and multiple incident reporting types in this study is reflected in the literature. Only the SFEP (WHO, 2017) refers to some sort of best practice transfer,

identified in terms of technical guidance and assistance on risk communications. There is no reference to diverse communication forums or similar concepts in any of the frameworks, however a small number of studies and guidelines have raised the significance of diverse communication channels including social media for reaching the widest population (Stal, 2013; Collins et al., 2016). For the least important factor there is some support in the DP model (Sutton and Tierney, 2006) which identifies the establishment of a National Incident Management System.

8.3.4.2 Risk and Hazard Management Subcriteria

For the Risk and Hazard Management criterion the relative importance of five subcriteria were compared. Risk and hazard analysis was assigned considerably higher importance relative to the other subcriteria. Hazard management planning and documenting risks were perceived to have similar and more moderate significance. Forecasting and modelling was prioritised to a lower degree, while hazard specific training was the least significant risk factor for crisis readiness.

Comparison of this finding with the literature confirms the significance attached to risk and hazard analysis for effective crisis readiness and response. A strong consensus is evident across different frameworks and literature that risk assessment and hazard monitoring are key components of successful emergency management and essential to crisis preparedness (FEMA, 2001; EU, 2011; IASC, 2013; OECD, 2013; WHO, 2015; WHO, 2017). The moderate importance attached to hazard management planning is in general alignment with the literature in which this aspect is represented to a varying extent. CAR is the only framework to specifically acknowledge hazard management planning, linked to the distinct hazard management criterion and expressed in terms of the establishment of a coordinated plan to mitigate hazards and restore essential functions (FEMA, 2001). Beyond the frameworks this factor most commonly emerges within discussion and theoretical models of hazard management for crisis preparedness (Davies and Walters, 1998; Perry and Lindell, 2003; McConnell and Drennan, 2006).

The relatively moderate positioning of documenting risks aligns with the literature, and there is no evidence in any of the frameworks of an explicit reference to the documentation of risks. However many of the processes proposed under this criterion may imply that risks are documented, such as the risk and hazard assessments included

across all the models. There is some evidence to show that the development and maintenance of a risk register as a form of documenting risks is a common policy at national level within developed economies (GovUK, 2017; OECD, 2018).

The finding for forecasting and modelling contrasts with the literature which appears overall to give more weight to this aspect for effective crisis readiness. Two of the frameworks specifically address forecasting and modelling within the risk and hazard management criterion and focus on the use of predictive and modelling technologies (DP model) and event risk assessments (SFEP) (Sutton and Tierney, 2006; WHO, 2017). Some emphasis on this factor is further evident in wider literature which identifies the importance for risk assessment as well as exploring appropriate approaches and tools (OECD, 2013; EU, 2016; Wilkinson, 2018).

8.3.5 Low Level Criteria

Finally of all the criteria evaluated in the AHP four were perceived to be least important relative to the other criteria: Early Warning, Legal and Institutional Frameworks, Recovery Initiation and Property Protection. There was much less importance attached to these criteria as evidenced by considerably lower ratings. Property Protection was perceived as least important of all ten criteria by a significant margin compared to the top criteria. While the relative significance of Recovery Initiation and Property Protection aligns with the literature, there is less consistency for Early Warning and Legal and Institutional Frameworks.

Examination of the existing frameworks indicates that these criteria are addressed to varying degrees with differing levels of detail. The Early Warning criteria is explicitly identified across all of the frameworks which specify necessary attributes and provide guidelines for effective early warning systems. Predominantly it is characterised as a key component of other criteria in the frameworks such as Resources (CP model) or Information Management (SFEP) (FEMA, 2001; Sutton and Tierney, 2006; IASC, 2013; WHO, 2017). Within the broader crisis readiness literature there is limited evidence of a specific research focus on early warning (Collins et al., 2008). Rather early warning has often been discussed within the context of overall hazard monitoring and forecasting (Singh and Subramaniam, 2009; Hense et al., 2010).

Legal and institutional frameworks are included in three of the four frameworks excluding the DP model and generally forms a distinct criterion. Discussion is detailed on the important components and dimensions for an appropriate legal and institutional context for enhancing crisis readiness, underlining the significance of developing policies and legislation that integrates emergency preparedness across sectors (FEMA, 2001; IASC, 2013; WHO, 2017). While literature on legal and institutional aspects is relatively limited, the debate is revealed to be multi-dimensional and inclusive of multiple levels, and frequently embedded in wider discussion of crisis governance (Tierney, 2012; Seng, 2013). The literature shows that there are implications for achieving an effective legal and institutional environment conducive to crisis readiness and response. Different factors influence effective regimes including the specific context and localities as well as the range of issues and areas to be addressed by policies, legislation and institutional arrangements (Mattingley, 2002). Seng (2013) shows that implementation of multilevel and decentralised architectures, frameworks and structures can support effective crisis response however full implementation of such arrangements represents a central challenge.

Recovery Initiation is mentioned in two of the frameworks only and which diverge from each other in terms of the importance placed on this criterion. While the DP model (Sutton and Tierney, 2006) proposes recovery as a separate criterion and provides key elements and factors, in the SFEP framework Recovery Initiation is considered only as a component of response planning (WHO, 2017). The finding for Property Protection is reflected in the literature which overall places less emphasis on this criterion than most other criteria. Protecting property is represented in only one of the existing frameworks (DP model) that provides detail on the core components and elements (Sutton and Tierney, 2006).

For this particular study due to time constraints in conducting a large number of matrices the subcriteria for these criteria were not evaluated during the AHP analysis to streamline the process. Qualitative findings however in the earliest rounds of the Delphi revealed a number of subcriteria associated with each of these criteria. For early warning five subcriteria were identified: advanced warning system, comprehensive intelligent monitoring, alarm systems, social media and communication. The existing frameworks

mention these subcriteria to varying degrees. Most of the frameworks refer to warning or alerting systems and monitoring. According to the Disaster preparedness model the establishment of a warning system includes developing protocols and procedures, regular testing and support, and addressing interoperability between organisations and personnel (Sutton and Tierney, 2006).

Four subcriteria were proposed for Legal and Institutional Frameworks of: supportive legislative framework; evidence-based; collaboration and regular review and update. To some extent there is a lack of support in the frameworks for these subcriteria in terms of the legal dimension. Nevertheless collaboration in crisis readiness governance appears to be implied in the emphasis placed in both the CFP and SFEP on multisectoral legal and institutional frameworks (IASC, 2013; WHO, 2017). Recovery initiation was associated with four subcriteria of recovery and continuity planning; cross-sector agreements; loss/damage assessment, and performance evaluation. For the Property Protection criterion four subcriteria of critical infrastructure planning, prevention of property damage, property protection legislation and property protection awareness were identified.

8.3.6 Key Performance Indicators

A goal of this study is to identify the key performance indicators (KPIs) for evaluating the effectiveness of different dimensions of CR. To achieve this aim practitioners generated a list of performance measures and process indicators in early rounds of Delphi that addressed different dimensions of crisis readiness. A shortlist of 35 KPIs for the top six criteria were then presented to participants in the final round of the AHP process to evaluate and define their importance relative to each other. The results showed that for certain criteria priority was focused around a single or small number of indicators while for others the relative significance of each indicator was more balanced.

8.3.6.1 KPIs for Response Planning

For the response planning criterion three KPIs were evaluated in total: coordinated planning processes, continuous planning and qualified planners. For this and all other criteria there is a lack of discussion in the literature and identification of KPIs for crisis readiness. While there is minimal prescription and definition of KPIs for any criteria or subcriteria nevertheless there are some indications that lend weight to the findings of this

study in underscoring the significance of the KPIs arising from this research. The findings showed that coordinated planning processes was the highest rated KPI by a significant margin. Eriksson (2010) provides validation for the importance of this measure as an indicator of planning performance. Coordinated planning in terms of aligning aims and goals across agencies and sectors and at all levels emerged as a major implication vital to shaping effective crisis planning. Both Boin (2010) and Tierney et al., (2001) provide further support for the importance of this measure, stressing that an organisation's planning should be integrated with the planning of all other relevant actors.

Continuous planning was the second highest rated KPI that attracted much greater priority weighting than the third and last KPI. Eriksson (2010) provides support for this measure in finding that the creation of continuous planning processes is a key implication for crisis planning. Further rationale is provided in work by Bayntun et al., (2012) which finds that continuous planning is essential to strengthening crisis preparedness at national level. Bayntun et al., (2012) provide some indication of further aspects to measure under this indicator, showing that continuous planning involves a process of reflective research and a database or collated resource to identify lessons from past disasters.

8.3.6.2 KPIs Resources

For the Resources criterion a total of five KPIs were prioritised against each other: Qualified Human Resource Ratios; Funding Availability; Technical Resources Availability; Facilities and Equipment Availability, and Periodic Review and Maintenance. The highest rated indicator was associated with the human resources factor, and specified evaluation of the ratio of trained and qualified staff. Qualified Human Resource Ratios was assigned one of the highest weightings for any KPI of 41.5%. The Funding Availability KPI was of moderate importance in comparison while exhibiting a large gap in priority in relation to the remaining three KPIs. Both the Technical Resources Availability and Facilities and Equipment Availability KPIs were rated equally significant, while Periodic Review and Maintenance was rated of significantly less importance to measure than any of the other KPIs.

The importance attached to evaluating human resources is reflected in the literature and widely identified as a critical aspect for enhancing crisis readiness performance (WHO, 2012; Athamneh, 2018). In particular this is consistent with a KPI identified by the

WHO's (2012) framework for assessing system capacity for crisis management which defines the quantification of trained human resources based on needs assessment. The literature provides further detail and measures for evaluating the human resources component for crisis readiness. ISO crisis management standards identify embedding training needs within annual performance goals and targets as a key measure (PAS 200:2011 ISO, 2011).

The next highest KPI was availability of funding, aligning with much of the literature which endows this measure with critical significance for evaluating crisis response. The SFEP model (WHO, 2017) specifically identifies availability and access to financial resources and contingency funds as a dimension of Resources, pointing to the importance of evaluating this factor. This KPI is underlined in the literature in terms of its relationship to all other factors and as the basis upon which all other attributes of reliable crisis response depend (Frederickson and LaPorte, 2002). In particular the literature also suggests measuring the speed and timeliness of financial resources as this is associated with contributing to organisational resilience during crises (Kovoor-Misra, 1995; HofferGittel et al., 2006). More specifically several of the frameworks suggest the importance of the availability of different funding mechanisms and mutual aid agreements at all levels (FEMA, 2001; IASC, 2013).

8.3.6.3 KPIs for Training

For the Training criterion a total of nine performance indicators were compared, with findings revealing that the importance attached to these KPIs was relatively balanced across the majority of the indicators. Continuous Training was the most significant KPI by a small margin over Training Modes Implemented, Frequency and Types of Exercises, Training Evaluation and Training and Capacity Standards. Four other KPIs were clustered at a lower level and received the least weightings of Ratio of Accredited Training Programmes; Number of Training Courses Implemented; Multi-Hazard Capacity Assessment and Use of Virtual, AI and Simulation Technologies.

When comparing the literature, there is some validation of the primary importance assigned to evaluating the continuous nature of training in this study. Empirical research on crisis readiness and disaster management across different geographies and different sectors has explicitly identified or referred to continuous training as a key enabler (Prizzia

and Helfand, 2001; Bahrami et al., 2014). A major recommendation proposed by Prizzia and Helfand (2001) for improving the emergency preparedness of Hawaii is continuous training for emergency coordinators.

Support is provided in the literature for the significance of KPIs based on training modes and frequency and types of exercises. In the WHO's (2012) capacity assessment framework measures are proposed that focus both on evaluating training modes, and frequency of training and exercises and drills. Further validation is provided by ISO crisis management standards which specify the inclusion and assessment of different types of exercises and drills (PAS 200:2011 ISO, 2011). In terms of Training Evaluation and Training and Capacity Standards KPIs there is some alignment with the literature which suggests the importance of measuring these aspects. Evaluation of training and exercises is a specific component of FEMA's (2001) CAR framework and is linked to undertaking further corrective action.

Some literature has focused on exploring and defining the methodologies and measures that can be applied to assess the outcomes of training and exercises (Sinclair et al., 2012; Beerens and Tehler, 2016). However in their review of the literature on disaster exercise evaluation Beerens and Tehler (2016) find that overall there is significant scope to advance the field which to date is under-researched and fragmented across disciplines. There is a strong implication therefore to develop performance indicators that are based on robust research and evidence of applicability.

8.3.6.4 KPIs for Co-ordination

For the coordination criterion six KPIs were evaluated and are presented in order of importance: Equipped Operations Centres; Crisis Appropriate Operational Protocols; Information Exchange Mechanisms; Inter-Agency Coordination Mechanisms; Defined Roles and Responsibilities, and Public and Community Coordination Mechanisms. Overall the difference in weights between the KPIs is relatively small although there is a significant drop in rating for the lowest factor of public coordination mechanisms.

The priority placed on equipped operations centres is validated in the literature in which this aspect is consistently mentioned in evaluation frameworks and key performance measures (Quarantelli, 1997; Larson, 2008; OCHA, 2013). Quarantelli (1997) identifies a well-functioning emergency operations centre as one of ten criteria for evaluating the

management of community disasters. Furthermore the establishment and maintenance of an emergency operations centre is a key organisational measure within Larson's (2008) framework for evaluating emergency preparedness plans and response strategies.

Meanwhile the significance accorded to evaluating inter-agency coordination in this study is supported by the literature. Inter-agency coordination is identified as the key attribute to assess by Gonzalez and Bharosa (2009) who emphasise the relationship between inter-agency coordination challenges and information quality dimensions in their evaluation framework for crisis response. Gilissen et al., (2016) further propose interagency coordination and specifically the distribution or responsibilities among crisis actors as one of seven performance indicators for evaluating emergency management systems. An emerging research focus is the real-time evaluation of inter-agency coordination during crises (Polastro et al., 2011; Slim, 2012).

Public and community coordination mechanisms were considered the least important indicator. To some extent this does not reflect the importance placed on evaluating this aspect identified across several assessment frameworks. The WHO (2012) for example specifically identify mechanisms of coordination and partnership-building as a key assessment component associated with six performance indicators, while Gilissen et al., (2016) integrate community coordination mechanisms within a more generalised indicator of community preparedness.

8.3.6.5 KPIs for Information Management and Communication

Seven KPIs were evaluated for their relative importance for measuring the information management and communication criterion. These were: Communication Time to Response Teams; Number of Information and Reporting Mechanisms, Smart Application Use in Incident Reporting, Multilingual Communication Mechanisms; Public Information Programmes Implemented; Data Collection Mechanisms and Trained Media Response Units. Analysis revealed that the most important performance indicator was communication time to response teams. Panel members accorded this measure the highest relative weighting for any performance indicator and there was a significant margin of difference with the next three most highly rated KPIs. Lowest priority was given to three KPIs focused on public information programmes, data collection and media response.

While the significance of this measure closely links to the goal to enhance crisis response times, there is minimal support for this KPI in the literature overall which does not specifically distinguish time to response teams as a performance indicator. To an extent this is reflective of the focus of the literature which largely centres on evaluating broad components of communication within large-scale disasters and emergencies (Larson, 2008; PAS 200:2011 ISO, 2011; WHO, 2012). For example the existence of an emergency reporting system is a key performance indicator in WHO (2012) evaluations of crisis management capacity. Hiltz et al., (2014) note that few studies have generated quantitative measures of reporting timeliness. One study explores the efficiency of information processing in emergency operations centres however does not provide any performance measures (Ichinose et al., 2014).

The results showed that number of information and reporting mechanisms, smart application use in incident reporting, and multilingual communication mechanisms were accorded a moderate level of priority. There is some validation in the literature for the importance of these aspects as performance measures. Moreover in regards to smart application use, there is a body of research which has examined this aspect as an increasingly significant component of crisis communication and information management (Houston et al., 2015; Reuter et al., 2018), suggesting that the literature supports the importance of evaluating this aspect. However few studies as yet have operationalised this attribute as a key performance measure. An exception is the ISO standard which stresses the utilisation of applications and social media platforms as critical to crisis communication (PAS 200:2011 ISO, 2011). Evidence shows that the availability of multiple channels and mechanisms for information and reporting is evaluated to some extent in research and practice. In this respect Larson (2008) identifies the level of development in the methods used for disseminating warning and risk communication as a key performance measure.

8.3.6.6 KPIs for Risk and Hazard Management

In regards to Risk and Hazard Management five KPIs were rated in terms of relative importance: Hazard and Risk Monitoring; All Hazards Risk Register; Risk Communication Plan; Plans for Specific Risks, and Frequency Risk Register Reviewed. The first three KPIs were relatively similar in importance with small difference in ratings.

There was a larger difference in rating for the next KPI of plans for specific risks while the frequency of risk registry review was rated the least important factor by some margin.

The most prioritised performance indicator for crisis readiness was continuous hazard and risk monitoring. This KPI finds some support in the literature to the extent that it is accorded some importance within practice and assessment frameworks. The EU (2018) underlines continuous surveillance using a range of technological systems as a major element of risk and crisis management. Similarly UNHCR (2018) proposes regular risk monitoring as one of the most important minimum preparedness measures and outlines four key indicators that can be used to assess continuous monitoring activities. The approach to emergency response preparedness adopted by the IASC (2017) task team stresses ongoing risk analysis and monitoring conducted at regular intervals as one of three fundamental components.

Importance was also accorded to the presence of an all-hazards risk register and risk communication plan which ranked second and third respectively in priority weightings. These KPIs find some validation in the literature as an all-hazards approach is a major feature within crisis readiness research and practice aiming to generate a form of emergency planning and response adaptable to a broad range of conditions (Tierney, 2007; Alexander, 2009; Bullock, 2011). The US government has adopted the all-hazards response model as its fundamental paradigm for crisis response planning (Barnett et al., 2005). Furthermore all-hazards approaches to risk and hazard management are applied as a performance indicator in numerous studies on disaster and crisis readiness across a wide range of sectors (Pollet and Cummins, 2009; Zantal-Wiener and Horwood, 2010).

8.4 Conclusion

This study focused on an investigation into crisis readiness and response of police in the UAE and the development of a strategic framework that would support policy and strategies to improve significantly police response times to road traffic crises. The chapter presented a discussion of the findings from an investigation into the key criteria, subcriteria and indicators that can inform a strategic framework that supports crisis readiness and response planning in the UAE. The discussion is structured in relation to the five research questions drawing on the qualitative and quantitative data generated by a Delphi panel and secondary data and organisational data. In relation to the first research

question of the existing strategies and practices for crisis readiness and response for Police in the UAE, the gaps in implementation relative to literature and theoretical dimensions and principles were discussed. Analysis of the existing practices and strategies also discussed the barriers impeding a comprehensive and inclusive approach to crisis readiness. It was evident that gaps and challenges in key areas of crisis readiness validated the requirement for development of a comprehensive strategic framework and key performance indicators. A discussion of the primary data from the Delphi process and panel experts from the UAE identified and prioritised the strategic criteria and subcriteria for crisis readiness. The discussion addressed the relative significance of different criteria and subcriteria grouped into top level, mid-level and lower level and the implications of these rankings were discussed in regards to the literature and theory. This discussion further addressed the perspectives of practitioners and weightings attached to key performance indicators across the different criteria and subcriteria. These findings informed the strategic framework to enable the UAE police to optimise crisis response and measure and evaluate crisis readiness performance in the area of road traffic crises.

CHAPTER 9: CONCLUSION

9.1 Introduction

The increasing volatility of the environment arising either from human or natural events has placed greater significance in theory and praxis on crisis readiness and the capacity of institutions and society to respond effectively. The research problem for this study was stated within the context of the UAE and the gap between national and international practices in terms of response times of law enforcement and a comprehensive strategic framework that defines the key criteria and performance indicators. While national level frameworks have been developed for major disasters and emergencies, sector or context-specific models have yet to be addressed.

The purpose of this study has been to investigate crisis readiness and response of Police in the UAE and establish the key dimensions that contribute to a comprehensive strategic framework that supports readiness and response planning to improve Police response times to road traffic crises. Further, this study presents knowledge in the crisis field in the specific context of law enforcement and road traffic crisis readiness. The central focus of this research has been to define and validate the key dimensions, factors and indicators and provide a systematic model to enhance comprehensive planning. The conceptual framework for this research integrated key disaster and crisis theory and frameworks. Specifically, the research focused on five key research questions:

1. What are the existing strategies and practices for crisis readiness and response for Police in the UAE?
2. What factors and elements of crisis readiness based on theory and praxis are critical for the specific context of improving response times to road traffic crisis in the UAE?
3. What are the perspectives of practitioners of crisis readiness of the police and how do they prioritise and weight the different strategic factors and performance indicators?
4. What are the barriers that obstruct the development and implementation of UAE's performance indicators, focused on law enforcement participation within UAE road crises situations?

5. What strategic framework can be proposed that will enable the development of strategies and performance indicators to enhance response times of police to road traffic crises?

9.2 Summary of the Research Process

The research process was based predominantly on the Delphi Method which is an analytical process that allows the researcher to attain a consensus of opinion from an expert panel of experienced professionals on specific real-world issues. Participants were drawn from a cross-section of public sector directorates and command authorities at federal and local level in the UAE and purposively selected for their specialist knowledge, proven experience and qualifications in the field and professional status or positions in their respective organisations. In a multistage process across four rounds of Delphi quantitative and qualitative data was collected on the criteria, subcriteria and key performance indicators critical to improving police response times to road traffic crisis situations.

The first stage of Delphi utilised an online unstructured questionnaire to gather practitioners' perspectives on what subcriteria and key performance indicators for each of the sixteen crisis readiness criteria identified from theory and practice they considered important for improving road traffic response times. Responses were thematically analysed and the results formed the basis for the following stages by providing information on each criteria of crisis readiness that could be used to identify alternatives, priorities and preferences.

The second Delphi phase applied a semi-structured questionnaire to collect quantitative and qualitative data that could validate the criteria, subcriteria and performance indicators collectively generated in the first round. The summarised results were presented to participants that provided an opportunity for clarification and refinement and to rate and review each criterion as well as their associated subcriteria and performance measures. The results were used to establish preliminary priorities among items and form early consensus on the importance of different elements at different levels of crisis readiness. Responses were thematically and statistically analysed and items with the least consensus were eliminated to increase the manageability of the next round in which the AHP was applied.

The third round used an AHP framework to collect quantitative data to derive the criteria, subcriteria and key performance indicators evaluated as most important by practitioners for optimising road traffic response times. This allows decision-makers to generate multi-objective and multicriteria decisions on any number of alternatives based on the simplification and systematic resolution of problems. Responses were statistically analysed to enable identification of the specific hierarchy and comparative importance of criteria, subcriteria and indicators. The results informed the proposal of a strategic framework identifying the key dimensions and subcriteria of crisis management and response. The fourth round of the Delphi provided a final opportunity to practitioners to revise and refine their judgements and finalise the strategic framework based on the research findings using a questionnaire containing open-ended questions which was subsequently thematically analysed.

9.3 Summary of Key Findings

This section summarises the key findings of this study specifically in relation to the objectives of the research. The first question of this study addressed the existing strategies and practices for crisis readiness and response for Police in the UAE. Findings evidenced that the UAE had formally established a disaster and crisis readiness programme nationally which defined key strategies, objectives, planning, structures, roles and responsibilities at all levels of crisis response. In the specific area of law enforcement and traffic response the government prioritises improvement in police capabilities to respond in an integrated approach across multiple dimensions. A proactive approach to capacity building and governance to respond to national disasters represented a major component of the existing framework where the UAE has been highly proactive in building its capacity and defining key roles. A major gap was identified in relation to response times as a critical measure of crisis readiness and a broader system of benchmarks and key performance indicators as a measure for evaluating the effectiveness of police crisis response. International comparisons showed that average response time in the UAE was significantly higher than other countries and global best practice. Internal analyses indicated that effective coordination is hampered by an absence of appropriate policies and mechanisms and understanding of the key dimensions and interaction between crisis readiness factors.

Table 9-1 Summary of KPIs for Top Level Crisis Criteria

Crisis Criteria	Key Performance Indicators
Response Planning	• Coordinated Planning Processes • Continuous Planning • Qualified Planners
Resources	• Qualified Human Resource Ratios • Funding Availability • Technical Resources Availability • Facilities and Equipment Availability • Periodic Review and Maintenance
Training	• Continuous Training • Training Modes Implemented • Frequency and Types of Exercises • Training Evaluation • Training and Capacity Standards • Ratio of Accredited Training Programmes • Number of Training Courses Implemented • Multi-hazard Capacity Assessment • Use of AI and Simulation Technologies
Co-ordination	• Equipped Operations Centres • Crisis Appropriate Operational Protocols • Information Exchange Mechanisms • Inter-Agency Coordination Mechanisms • Defined Roles and Responsibilities • Public and Community Coordination Mechanisms
Information and Communication Management	• Incident Communication Response Time • Number of Information & Reporting Mechanisms • Smart Application Use in Incident Reporting • Multilingual Communication Mechanisms • Public Information Programmes Implemented • Data Collection Mechanisms • Trained Media Response Units
Risk and Hazard Management	• Continuous Hazard and Risk Monitoring • All Hazards Risk Register • Risk Communication Plan • Plans for Specific Risks • Frequency Risk Register Reviewed

The second key research question focused on the factors and elements of crisis readiness that are critical for the specific context of improving response times to road traffic crisis. The qualitative and quantitative research conducted in this study provided primary data to identify and validate the key dimensions for crisis readiness. Findings

from initial rounds of the Delphi process showed that of 16 theoretical dimensions derived from theory and literature experts identified the top 10 most critical components of crisis readiness. These criteria were then subject to an Analytical Hierarchy Process (AHP) in which the relative prioritisation and ranking of these criteria were identified. The results clustered into 3 distinct sets of ranking; four criteria of Response Planning, Resources, Training, and Coordination received the highest level of priority by the panel; Information Management and Communication and Risk and Hazard Assessment were ranked at mid-level importance. The remaining four criteria were accorded a lower level of priority: Early Warning, Legal and Institutional Frameworks, Recovery Initiation and Property Protection.

Qualitative findings further indicated a broad range of subcriteria for each criterion proposed by practitioners. In a second phase of AHP experts were able to identify the relative importance of the subcriteria for each of the top 6 six criteria. These findings provide validation for the key criteria established in the literature and CR frameworks and the relative priority of different criterion and subcriteria. Furthermore, qualitative data suggests a strong relationship and interdependency between different criteria and subcriteria in this study. This study also investigated the perspectives of practitioners of crisis readiness of the police and how they prioritise and weight the different strategic performance indicators proposed in the initial rounds of Delphi. The results from this study validated a broad set of KPIs for the top six ranked criteria. The KPIs summarised in Table 9-1 reflect the priorities of key performance indicators as perceived by the expert panel in the context of law enforcement traffic response.

Another focus of this study was to investigate the barriers that obstruct the development and implementation of UAE's performance indicators, focused on law enforcement participation within UAE road crises situations. The findings from secondary and primary qualitative data suggested a number of antecedents associated with inter-organisational, structural and national cultural factors as well as the application of different frameworks. Operational level antecedents were identified in respect of interoperability, resources, organisational culture and clandestineness and power. The results suggested that such factors impact on the efficiency and effectiveness of the existing approach to crisis readiness.

Table 9-2 Strategic Framework for Crisis Readiness and Response

Ranking	Criteria	Subcriteria	Key Performance Indicators
1	Response Planning	1.1 Joint Response Planning 1.2 Resource Planning 1.3 Roles and Responsibilities 1.4 Regular Review and Update	1.1 Coordinated Planning Processes 1.2 Continuous Planning 1.3 Qualified Planners
2	Resources	2.1 Human Resources 2.2 Physical Resources 2.3 Logistics and Facilities Capabilities 2.4 Advanced Technological Resources 2.5 Maintenance of Logistics Systems 2.6 Logistics Planning	2.1 Qualified Human Resource Ratios 2.2 Funding Availability 2.3 Technical Resources Availability 2.4 Facilities and Equipment Availability 2.5 Periodic Review and Maintenance
3	Training	3.1 Continuous Leadership Development 3.2 Field Training 3.3 Exercises 3.4 Technical Training 3.5 Equipment Training 3.6 Theoretical Training 3.7 Inter-agency Exercises 3.8 Virtual Simulations 3.9 Database of Resources and Capacities 3.10 Adoption/Benchmarking of Best Practice	3.1 Continuous Training 3.2 Training Modes Implemented 3.3 Frequency and Types of Exercises 3.4 Training Evaluation 3.5 Training and Capacity Standards 3.6 Ratio of Accredited Training Programmes 3.7 Number of Training Courses Implemented 3.8 Multi-hazard Capacity Assessment 3.9 Use of AI and Simulation Technologies
4	Coordination	4.1 Operational Planning 4.2 Coordinated Operational Procedures 4.3 Inter-agency Coordination 4.4 Joint Training 4.5 Centralised Coordination Systems 4.6 Public Coordination	4.1 Equipped Operations Centres 4.2 Crisis Appropriate Operational Protocols 4.3 Information Exchange Mechanisms 4.4 Inter-Agency Coordination Mechanisms 4.5 Defined Roles and Responsibilities 4.6 Public and Community Coordination Mechanisms
5	Information Management and Communication	5.1 Strategies and Policies 5.2 Advanced Communication Systems 5.3 Public Education & Information Programmes 5.4 Multi-channel Communications 5.5 Inter-agency Communication 5.6 Transfer of Best Practice 5.7 Diverse Communication Forums 5.8 Multiple Incident Reporting Types	5.1 Communication Time to Response Teams Following Incident Report 5.2 Number of Information & Reporting Mechanisms 5.3 Smart Application Use in Incident Reporting 5.4 Multilingual Communication Mechanisms 5.5 Public Information Programmes Implemented 5.6 Data Collection Mechanisms 5.7 Trained Media Response Units

Ranking	Criteria	Subcriteria	Key Performance Indicators
6	Risk and Hazard Management	6.1 Risk and Hazard Analysis 6.2 Hazard Management Planning 6.3 Documenting Risks 6.4 Forecasting and Modelling 6.5 Hazard Specific Training	6.1 Continuous Hazard and Risk Monitoring 6.2 All Hazards Risk Register 6.3 Risk Communication Plan 6.4 Plans for Specific Risks 6.5 Frequency Risk Register Reviewed
7	Early Warning	Advanced Warning System Comprehensive Intelligent Monitoring Alarm Systems Social Media Communication*	Number of Times EWS Tested and Updated Diverse Communications and Warning Mechanisms Social Media Integrated into EWS Quality and Appropriateness of Content e.g. (Timing, Location and Severity) Speed of Warning Through Integrated Electronic Systems Data Collection and Monitoring Mechanisms**
8	Legal and Institutional Frameworks	Supportive Legislative Framework Evidence-Based Collaboration Regular Review and Update*	Mandates Defining Roles and Responsibilities Mechanisms to Enforce Compliance Legally Mandated Financial Resources Evaluation of Quality of Legal Frameworks in Addressing Traffic Crises (Questionnaire)**
9	Recovery Initiation	Recovery and Continuity Planning Cross-Sector Agreements Loss/Damage Assessment Performance Evaluation*	Recovery Plan Recovery Priorities Identified Plan for Restoration of Critical Services and Facilities**
10	Property Protection	Critical Infrastructure Planning Prevention of Property Damage Property Protection Legislation Property Protection Awareness*	Property Protection Protocols Established Critical Infrastructures and Public Properties Identified Communication Mechanisms with Critical Infrastructures**

* = This list of subcriteria, identified as important in qualitative stage, was not subject to the AHP

** = This list of key performance indicators, identified as important in qualitative stage, was not subject to the AHP

The fifth research question of this study addressed what strategic framework can be proposed that will enable the development of strategies and performance indicators to enhance response times of police to road traffic crises? The findings from this study informed the strategic framework to enable the UAE police to optimise crisis response and measure and evaluate crisis readiness performance in the area of road traffic crises. Presented in Table 9-2 the framework prioritises the key criteria, subcriteria and performance measures that support the systematic design and evaluation of the effectiveness of these dimensions. These were validated through the AHP process in the case of the top six criteria. The subcriteria and performance measures for the remaining four criteria were identified in earlier rounds of the Delphi however their relative priority and importance in relation to each other has not been established in this study.

9.4 Research Contribution

This research makes several key contributions to theory and praxis. Firstly, this study has expanded understanding in this field by identifying the key dimensions and factors of crisis management and response. This research contributes understanding and identification of factors that support the development of a comprehensive plan that defines critical mechanisms and processes that can be applied for the development and enhancement of the crisis readiness of road traffic agencies. This study makes a significant contribution to both academic and practical fields. A management tool is advanced to structure the planning and evaluation of crisis readiness programmes and the development of future strategies around critical dimensions and factors. Further the findings are derived from experts operating within an Arab cultural context and the culture of the UAE. The study contributes a framework for practice in which the priorities for crisis readiness and response and the challenges identified emerge from within this specific cultural context.

The findings contribute a comprehensive strategic readiness framework that supports strategic planning and decision-making for the development of organisational capacities that can enhance response times of police to road traffic crises. A wide range of factors identified in the literature were subject to systematic analysis and multi criteria decision making process that prioritised the different dimensions and elements that are critical for crisis response and readiness. This addresses a gap in research for a comprehensive crisis

readiness and response framework that defines the key criteria and performance indicators at a local or agency level. This study presents a novel framework that comprehensively addresses the key dimensions and factors of crisis readiness and therefore provides a holistic model to guide development of measures focused on all critical areas. This has resulted in the identification of key criteria and subcriteria that enable crisis response. Further, the model ranks each dimension in order of priority and relative importance and then ranks within each dimension the relative importance of key subcriteria. This ranking can support the clarification of achievements and support identification of gaps and monitoring of factors and specific elements of crisis readiness. This model validates the key components of crisis readiness both theoretically based on a review of the literature and primary data validation by a panel of experts in the field based on a systematic quantitative analytical process. Validation of the core dimensions can support practitioners to structure and support development and exploration and standardisation of key processes as well as benchmarking and analysis.

At another level this study contributes a shortlist of key performance indicators for the top six criteria which were evaluated and defined in terms of their relative importance. While there is minimal definition of KPIs in the literature some indications lend weight to the findings of this study in underscoring the significance of the KPIs arising from this research. This identifies specific indicators classified under each of the top six criteria that support the development and evaluation of crisis readiness. For praxis these indicators represent a set of validated KPIS that can be integrated in existing crisis response plans to guide evaluation. At the same they provide focus for further research into the impact of KPIs on the performance of crisis response agencies and institution and programmes so that sub-elements can be identified and more closely aligned to critical processes. This may support the development of lower-level key performance indicators across the different criteria and subcriteria of crisis readiness and promotion of operational resilience and improvement of effectiveness and transparency of crisis readiness and response. The performance indicators identified provide a core set of indicators that provides foundation for development of a broad range or index of indicators.

9.5 Recommendations and Implications for Policy and Practice

The improvement of response time for law enforcement in UAE in crisis situations has been a priority for several years. The significant gap between international benchmarks and response times in the UAE is the central key performance measure that influences a wide range of dimensions and factors. In order to narrow the focus of actions policy development needs to generate solutions that address areas of under-performance and issues that impede on enhancement of crisis readiness. This research provides strategic guidance in the form of a prioritised list of criteria, subcriteria and KPIs that can direct efforts to optimise different dimensions of crisis readiness at a strategic and operational level.

Based on the findings in this study this section presents a set of recommendations that can inform both theory and praxis in the field to further promulgate and validate this framework. Policy development should focus development of measures in order of priority of criteria and factors validated in this study. This will ensure that measures are concentrated on critical dimensions of crisis response, which can form the primary agenda for working groups or policy development. Firstly, the approach may concentrate on the mapping of key roles, structures and processes specific to each area of priority. Secondly, policy development may consider the relationship and interaction between different strategic and operational dimensions of crisis readiness to foster an organisationally and functionally integrated model. Under each of the dimensions there are key recommendations that will contribute to the development of higher levels of crisis readiness.

The findings of this research clearly establish the top six criteria most important for effective crisis readiness. This points to a strong implication for organisational practice to ensure that these elements are fully represented in crisis readiness plans. Furthermore within each of these criteria the study identifies the most important subcriteria and components that comprise each criterion and these in turn should be considered and integrated within crisis readiness plans.

Response planning was ranked as the single most important component for effective crisis readiness and response. A primary challenge in this area is cultural or organisational

structural factors that may impede response planning processes. A key recommendation for organisations is to consider transformation of rigid and centralised structures towards decentralised, flexible modes of planning. This measure is consistent with the priority that is placed on dynamic and adaptive capabilities that extend beyond prescriptive plans and allow for greater autonomy and discretion. This approach would enhance agencies' and actors' effectiveness in addressing and responding to complex crisis events. Policy makers may consider a broader examination and identification of national and organisational cultural factors that create impediments to effective response planning. At individual level strategies may focus on fostering open planning processes and participation that fosters bottom-up employee and community engagement and decision-making and autonomy. The findings from this study suggest key inter-organisational factors that potentially impact on collaboration and co-ordination between organisations and agencies locally, regionally and nationally. Therefore design of crisis response planning may require attention to understanding and fostering of more open collaboration by addressing inter-organisational elements such as trust, culture, interoperability in information and communication. The design of response planning should be based on evaluation of in-depth understanding of the specific antecedents of response planning that enable or inhibit the crisis readiness and response. This may involve successfully addressing the multiplicity and differences in public coordination structures and organisational cultures influenced by different Emirati and national or local governance contexts. Consideration should be given to the development of strategies which help to address these differences based on understanding of key barriers and impediments. This may focus on mechanisms which align and clarify any ambiguity in coordination structures and harmonise competing interests to ensure effective vertical and horizontal coordination.

Resources are frequently identified in the field of crisis response as representing a major constraint. The findings imply for practitioners a multifaceted, multi-objective approach to resourcing. Firstly, more specific classification of resource, mapping and prioritisation of resources is underlined as a primary requirement and foundation for effective resource planning. Furthermore strategies and further research may focus on evaluating methods that promote the mobility and utilisation and overall efficiency of resources. A primary recommendation is for the development of tools and methodologies

that overcome resource constraint issues by enhancing integration, reducing redundancy and maximising resource-sharing and leveraging technological solutions for tracking and managing resources. Such measures depend critically on fostering high levels of inter-organisational co-operation and trust and knowledge sharing between agencies. These developments in turn place focus on developing effective structures and systems that ensure the full transparency and utilisation of available resources, and which facilitate information flows, data communication and data collection. Processes should be established that identify and address barriers to co-operation inter-organisationally and that promote optimisation and sharing of resources.

The study findings show that training is a complex issue involving multiple agencies, and overlapping roles and responsibilities across different operational fields and functions. A primary consideration should focus on clarifying the key goals, roles, responsibilities, structures and processes within all organisations. This would form the basis for the prioritisation and design and alignment of training programmes to address gaps and develop key competencies. Due to the high level of co-operation and collaboration between agencies in crisis response it follows that strategies should promote shared goals, cooperation and understanding between agencies and organisations to clarify boundaries, shared and distinct goals and roles. This can be linked to a central competency framework that defines knowledge and skills for all key roles and is linked to design and evaluation of training programmes. Defining the competencies necessary to achieve effective crisis response will enable agencies to efficiently and systematically identify skills and competency gaps and ensure that there is a sufficient base of expertise among agencies and frontline first responders by providing more customised training and professional development.

In respect of information management and communication this has been identified as fundamental to the effective implementation of most other dimensions of crisis readiness and response. In particular ensuring effective and seamless knowledge sharing between actors can provide the basis for the mobilisation of resources and for cohesive coordination and decision-making during crisis events. Study findings point to the need to develop strategies and structures for inter-organisational communication and knowledge sharing that ensures timely, accessible information to all relevant actors across

different organisations. In particular focus should be placed on the development of systems, structures and protocols that are interoperable and ensure that information can be rapidly and transparently shared between agencies, and incorporate social media and networked technologies. Enabling the efficient and timely flow of information further implies addressing organisational and cultural factors that may represent barriers to inter-organisational information sharing in the Arab and UAE contexts. The power differentials, hierarchy and trust-based relationships characteristic of the Arab workplace influences a tendency towards withholding information unless shared with trusted associates or for personal advantage and significant managerial control over inter-organisational knowledge sharing.

This study identified differences in the emphasis and value placed on risk assessment and hazard management in the UAE in comparison to broader literature and practice. In respect of this dimension some priority could be given to maturing and developing national capabilities, particularly in regards to the assessment, prioritisation and management of risks within specific contexts. Focus could be placed on ensuring greater definition and clarification in terms of hazard identification and risk assessment on the one hand, and hazard management on the other in line with the more developed guidelines and practices embedded in FEMA's (2001) framework.

While these recommendations are specific to the top six criteria, a comprehensive, complete approach to crisis readiness would extend to incorporating the full spectrum of other criteria identified in the top ten in this research: Early Warning, Legal and Institutional Frameworks, Recovery Initiation and Property Protection. Similarly integration of the full range of factors prioritised in this study associated with all of the dimensions of crisis readiness would provide a robust and complete approach.

This study has provided an initial framework of key performance indicators that represent critical KPIs that should be embedded where relevant within crisis readiness plans. Organisations furthermore could seek to develop and integrate a full range of KPIs that link to goals and each of the criteria and subcriteria identified. In addition organisations may find it valuable to conduct an internal process of identifying and selecting the most relevant KPIs to their particular situation and context and which can be used as benchmarks to monitor and evaluate all dimensions and factors of crisis

readiness. An integrated, inter-organisational platform could be used to monitor all of the KPIs.

9.6 Limitations

The findings of this study provide key insights and address gaps in knowledge in respect of crisis readiness and a comprehensive framework that defines key criteria and performance indicators for crisis readiness and response. However in applying the results of this study note should be taken of a number of constraints which could influence the ability to generalise to broader contexts or influence aspects of validity. The findings are based on a single case study focused on a specific area of operation within crisis response and one group of organisations of the UAE police sector. This potentially places a constraint on the wider generalisation of the findings to different operational areas and agencies as they may have different priorities or organisational conditions that have implication for the application of the framework and the relative importance of certain criteria and subcriteria.

Moreover the study findings are largely dependent on the Delphi method with the potential for any limitations in this technique to be reflected in the results. While Delphi generally favours smaller samples, the findings were drawn from a narrow, small group of practitioners within a specific context and lacked a broad enough spectrum to reflect all key organisations at every level such as regional and national. Thus, greater scope for generalisation could be achieved by inclusion of a broader range of experts representative of a full range of relevant organisations at all levels. In addition some authors note that the Delphi method is vulnerable to the tendency to ignore or exclude extreme positions and force a compromise consensus which may not contain the best judgement (Linstone and Turoff, 2002; Mitroff and Turoff, 2012). Despite drawing on quantitative data collection and analysis to generate the study findings there may also be an implication in respect of the subjectivity associated with the Delphi method and AHP analysis which can be influenced by cultural biases. According to Dalkey (1975) there is possible risk that this can lead to similar answers for questions where the answers are complex or

poorly known. In this case biases could arise in regards to both national and organisational culture.

9.7 Implications for Theory and Future Research

Notwithstanding these limitations, this study presents critical new opportunities for further research to enlarge understanding of crisis readiness and response both in the UAE and wider contexts. A key focus for future research could be to explore and validate the framework criteria and subcriteria in different organisational and sector contexts and at different levels. This could provide a broader range of perspectives that would assist in enhancing and updating the framework to increase its relevancy and applicability for a wider group of actors and agencies. In a similar vein, future research could include a wider set of stakeholders and community voices in development of readiness frameworks and emergency planning. Literature points to the growing phenomenon of citizen involvement in the response phase of crises and disasters as a result of social media. This suggests the need for further research to understand how to incorporate and design for this trend within crisis planning and frameworks. A further avenue for future research is the critical area of performance indicators, the construction of which are challenged by the complex relations between the event itself, the response, the vulnerability and the consequences. Greater quantification of these relationships could support the measurement and optimisation of crisis readiness as well as helping to gain acceptance for the results. Significant emphasis is also placed on learning from responses to crises and emergencies linked to the development of metrics and criteria for crisis readiness. There is particular value therefore in exploring methods to improve post-crisis reporting processes and to extract lessons learned across multiple incidents. These could be valuable mechanisms to detect gaps in response and areas for improvement.

The study findings point to implications for theory and research in terms of the clear identification of the top six criteria and subcriteria critical for effective crisis readiness. The priority placed on these elements suggests the importance of further developing theory in these areas and additionally in achieving a broader understanding of the key processes, components, antecedents, success factors and specific practices associated

with these top-level criteria and subcriteria and the effectiveness of different mechanisms and approaches.

Moreover to ensure the development of a complete theoretical approach research should seek to develop key antecedents, practices, components and processes critical to all of the top ten criteria identified in the findings. This would contribute to providing a full and balanced body of knowledge that addresses a full spectrum of criteria and factors identified in this research. Finally the findings suggest the value of further research to understand the complexity in terms of the relationship between crisis readiness criteria, as well as the relationship between subcriteria, the dependency between them and the moderators and mediators.

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Appendices

APPENDIX A – SYSTEMATIC LITERATURE RESULTS

Table A-0-1 Article Distribution Across Academic Journals

Journal	NO
Computing and Engineering	50
Logistics and Transportation	21
Emergency Science and Management	18
Crisis Analysis and Prevention	9
Information Management	6
Simulation and Modelling	5
Emergency Operations	3
Critical Infrastructure	2
Miscellaneous	11

Table A-2 Ranked and Non-Ranked Journals

Ranking	No Journals	%
5+	*4*	*3.2%*
4+	*3*	*2.4%*
3+	*8*	*6.5%*
2+	*3*	*2.4%*
1+	*4*	*3.2%*
0	*106*	*84.8%*
Total	*125*	*100%*

Table A-3 Key Thematic Areas in Crisis Readiness

Focus Area	No of Articles	Sample Articles
Road Accidents/Traffic Accidents	*45*	*Gaikwad et al., 2014; Yaacob et al., 2019; Matta et al., 2012; Nazif-Munoz et al., 2020; Zhao and Mao, 2009; Hilal and Yurdakul, 2020*
Crisis/Disaster Management	*17*	*Dar et al., 2019; Minas et al., 2020; Park et al., 2019; Crundall and Kroll, 2018*
Location Planning	*13*	*Boutilier and Chan, 2020; Oksuz and Satoglu, 2020; Lee et al., 2014; Hilal and Yurdakul, 2020*
Road Network Analysis and Vulnerability	*13*	*Zhong et al., 2020; Golla et al., 2020; Ahmed et al., 2018; Emadi et al., 2017*
Road Crisis	*11*	*Henchey et al., 2014; ul Hassan et al., 2020; Coles et al., 2017; Gajanayake et al., 2018*
Crisis Response	*8*	*Janati et al., 2018; Aghababaei et al., 2020; Kroll et al., 2020; Fard et al., 2017*
Emergency Preparedness	*8*	*Sheikhbardsiri et al., 2020; Coconea et al., 2014; Begum et al., 2019; Aini et al., 2001*
Hazardous Materials	*4*	*Crundall and Kroll, 2018; Manzoor, 2020; Ameryoun et al., 2020; Jabbari et al., 2020*
Accident Management	*4*	*Jamil & Khan, 2019; Goh et al., 2014; Sishwa et al., 2019; Sadeghi-Bazargani et al., 2020*
Internet of Things	*4*	*Jamil & Khan, 2019; ul Hassan et al., 2020; Dong et al., 2013; Liu and Wang, 2019*
Road Safety and Assistance	*4*	*Kumari et al., 2019; Gupta et al., 2019; Coconea et al., 2014; Kepaptsoglou et al., 2012*
Simulation Models and Tools	*4*	*Helsing et al., 2019; Filippoupolitis and Gelenbe, 2012; Deqi et al., 2012; Bae et al., 2017*

Table A-4 Studies by Year

Year	Total No of Studies in Year	Total No of Ranked Studies Only
1986	1	0
1995	1	1
2001	1	0
2004	2	2
2008	2	0
2009	2	1
2010	2	0
2011	1	0
2012	10	4
2013	7	3
2014	9	6
2015	1	0
2016	6	5
2017	9	6
2018	11	9
2019	21	17
2020	39	36

APPENDIX B – RESEARCH ETHICS FORMS

Participant Invitation Letter

Dear Sir/Madam,

RE: DEVELOPING A STRATEGIC FRAMEWORK TO ENHANCE READINESS OF UAE LAW ENFORCEMENT AGENCIES TO EFFECTIVELY RESPOND TO ROAD TRAFFIC EMERGENCIES

My name is …… and I am a doctoral student at ……. I am kindly requesting your participation in a PhD study I am conducting at the University of Salford.

The primary purpose of this research is to develop a strategic framework to enhance participation of law enforcement agencies within crisis and disaster response situations within the United Arab Emirates. You have been selected to participate as you have relevant knowledge and experience of the area we are researching.

Your participation would be through access to an online questionnaire system over 4 phases and the process will overall take about 3hrs.

As a participant there are no direct benefits to you, however the findings of the study may help improve understanding of crisis readiness in the UAE that will help guide organisational development and improvement of all organisations involved in this area.

If you are interested in participating in this research please reply to this email after which I will email you full details about the project. Please note that your participation is entirely voluntary and you are free to withdraw from the study at any point. The confidentiality of all information you provide will be maintained and your privacy fully protected. If you do not reply to this email you will not be contacted further.

Thank you for your attention,

Kind regards

Name:

Address:

Email Contact:

Participant Information Sheet

Research Title: Developing a Strategic Framework to Enhance Readiness of UAE Law Enforcement Agencies to Effectively Respond to Road Traffic Emergencies

Research Information

You have been invited to participate in this research project as a result of your knowledge, role within your organisation and/or experience within UAE crisis readiness and response which is the focus of this research.

Before you decide to take part in this research, it is important that you understand the reasons for the study. This information sheet will provide all the necessary information on the research project that will allow you to make an informed choice on whether or not you wish to participate. You may also wish to talk to others about the study and please take time to consider whether or not you wish to take part.

Please take the time to review and consider this information carefully and do not hesitate to request further information either by email or phone.

Thank you for reading.

1. What is the purpose of this study?

The primary purpose of this research is to develop a strategic framework to enhance participation of law enforcement agencies within crisis and disaster response situations within the United Arab Emirates. The strategic framework will be used to support decision-making to improve response times for Police for road traffic crisis situations.

2. Do I have to take part in the study?

Your participation is entirely voluntary and you are free to withdraw at any point from this study without providing any reason. Even after agreeing to participate in the study, you are still free to withdraw at any time without prejudice or providing any reason.

3. Why are you invited to participate in this project?

You have been selected to participate as you have relevant knowledge and experience of the area we are researching.

4. What will happen to me if I take part?

You will participate as a member of a Delphi panel which is a group of experts or professionals with in-depth knowledge and experience convened to examine a specific real-world issue and achieve a consensus of opinion. You will be asked to complete a series of online questionnaires which will be undertaken separately over a one to two-month period.

Your participation will be through access to an online questionnaire system where you will enter your responses. The process will overall take about 3hrs. If you agree to participate in the research, you will be emailed with a link to a secure website where you can access and complete the online questionnaire for each round:

- Round 1: Open questionnaire to get your views about 16 aspects of crisis readiness and response (Approx. duration 90mins)
- Round 2: In the second questionnaire you will be asked to rate and optionally comment on responses that have been aggregated and shared from Round 1 (Approx. duration 90mins)
- Round 3: You will be invited to complete a structured questionnaire using Analytical Hierarchy Process which is a technique to perform comparisons between combinations of factors and performance indicators identified in the previous rounds
- We will provide you with an extra information sheet that will explain more about AHP.
- Round 4: This will be an Open questionnaire where you will be emailed a summary of the findings and asked to evaluate and provide any feedback.

The data collected and information from the questionnaire will be anonymous and used solely for academic purposes.

5. Will I be paid for taking part?

You will not be paid for your participation in this research, but you may wish to request a short report on the research findings when the thesis write-up is completed.

6. What will happen to any data, information or samples collected from you?

Please be assured that confidentiality is highly protected in this research. Your responses and any data collected will be stored on secure computers in locked offices. All participants will be referenced by code, not by name, and any information that may identify you will not be recorded and your privacy will be maintained at all times. The data from the questionnaires will be anonymised in the case that the research supervisors or external examiners require access at the end of the study.

All information collected will only be used for the purpose of this study and kept confidential. To ensure the anonymity of the results, consent forms and questionnaires will be kept separate. All data will be collected, stored and disposed of securely, in accordance with the *General Data Protection Regulations* or GDPR (2018). Presentation of the study results will be anonymous to ensure that no participant can be individually identified.

7. What will happen to the results of the study?

The findings will be published in the form of a report, which will be included in a thesis that forms part of a post-graduate student's Doctorate degree. Furthermore, it is also likely that the researcher will write an academic paper based on the findings of this study, and that this paper will be published in professional journals or at conferences.

8. Does participation involve any risk or side effects and if so, what will be done to ensure my wellbeing and safety?

The risks involved in participating are minimal, and you are free to withdraw at any moment if you are concerned about your safety and wellbeing.

9. Your legal rights will not be compromised by agreeing to participate in this research

Your participation will be entirely anonymous and your privacy and data confidentiality will be protected at all times. Your consent to take part in this research should not compromise your legal rights should any risks occur.

10. Do any special precautions need to be taken before, during or after participating in the study?

No special precautions need to be taken to participate in this study. Simply allow for time to participate in the research activity. Online questionnaires will take between 1-1.5 hours to complete.

11. Are there any benefits from participating?

As a participant there are no direct benefits to you, however the findings of the study may help improve understanding of crisis readiness in the UAE that will help guide organisational development and improvement of all organisations involved in this area. Participants would share in the benefits of this research due to the potential for the knowledge to assist in developing strategies for improving response times of police at road traffic crises and to save lives. Such knowledge from this study would be fairly distributed to all academics and practitioners in the UAE and beyond.

12. What if there is a problem?

If you have any concerns about any aspect of this study, you may want to speak with the main researcher (see contact details below), who will answer your questions. However, if you are unsatisfied with his response, you may wish to forward your complaints directly by contacting the main supervisor (…….; by Email: ……@salford.ac.uk).

13. Who is undertaking this research?

This study is being conducted by **…….** in fulfilment of **Doctor of Philosophy** at **University of …….**

14. Who has reviewed the study?

The researcher's supervisors and The University of Salford Ethics Committee have reviewed all aspects of this study.

15. Funding of the Study

This research is being funded by the Ministry of Interior, UAE

16. Contact details for further information

Full Name:

Tel:

Email:

Address:

Supervisor's contact details:

Name:

Address:

Email:

Yours sincerely,

……, PhD Candidate

YOU WILL BE GIVEN A COPY OF THIS INFORMATION SHEET TO KEEP,

TOGETHER WITH A COPY OF YOUR CONSENT FORM.

Participant Consent

Research Title: Developing a Strategic Framework to Enhance Readiness of UAE Law Enforcement Agencies to Effectively Respond to Road Traffic Emergencies

Main researcher and contact details:

Sponsored by:

Members of the research team:

Please use the check box in the right corner after the statements.

1. I confirm my agreement to participate in the research project stated above.	☐
2. I confirm that I have read the Participant Information Sheet and understand fully what my involvement in this research entails. All my questions have been answered to my satisfaction.	☐
3. I fully understand that I can choose to withdraw from this study at any time for any reason without prejudice.	☐
4. I have been fully informed that the confidentiality of all information is maintained and appropriate measures will be undertaken to protect my privacy.	☐
5. I am aware that I may ask questions at any stage of the research process before, during and after the data collection.	☐
6. I provide my consent for any data I provide to be used for the purpose of this research as communicated to me, and given that the research is undertaken in compliance with Data Protection legislation	☐

Consent form (for use of quotes)

Please tick the box if you agree with the statement:

1.	I agree for my quotes to be used	☐
2.	I do not agree for my quotes to be used	☐
3.	I understand that data will be anonymised to protect my privacy	☐

_____	_____	_____
Participant's Name	Date	Signature
_____	_____	_____
Researcher's Name	Date	Signature

APPENDIX C – RESEARCH QUESTIONNAIRE

Questionnaire

Round 1

This questionnaire is part of the research for a PhD on ***Developing a Strategic Framework to Enhance Readiness of UAE Law Enforcement Agencies to Effectively Respond to Road Traffic Emergencies.*** The questions are related to different areas of crisis readiness and response.

Please read and answer the questions below. There is no fixed length for any questions and feel free to provide as much detail as you wish. You may provide your responses in a written format in the space provided. Alternatively if you prefer you may record an audio transcript and email the audio file to: *[emailaddress]*

Information Management and Communication

1a. What factors or processes of information management and communication do you perceive to be critical for the optimisation of response times to road traffic crises? Why do you think these factors are important?

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1b. What indicators or measures of performance do you think are important to apply?

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Risk Assessment

2a. What factors or mechanisms of risk assessment do you believe to be important for the optimisation of response times to road traffic crises? Please explain why.

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2b. What indicators or measures of performance do you think are important to apply?

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Resources

3a. In your view what factors or elements of resources are significant for improving response times to road traffic crises? Why?

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3b**.** What indicators or measures of performance do you think are important to apply?

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Coordination

4a. What factors or mechanisms of coordination do you believe to be vital to enhance response times to road traffic crises? Why do you think these mechanisms are important?

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4b. What organisational structures and stakeholder relationships can improve coordination to achieve this goal? Why?

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4c. What indicators or measures of performance do you think are important to apply?

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Response Planning

5a. What factors or processes of response planning do you perceive to be critical for the optimisation of road traffic crisis response times? Why do you think these factors are important?

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5b. What indicators or measures of performance do you think are important to apply?

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Training

6a. What factors or processes of training do you believe are important for improving response times to road traffic crises? Why do you think these factors are critical?

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6b. What indicators or measures of performance do you think are important to apply?

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Exercises

7a. What processes or mechanisms of exercises or simulations do you perceive to be critical for optimising road traffic crisis response times? Why?

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7b. What indicators or measures of performance do you think are important to apply?

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Hazard Management

8a. In your view is hazard management an important criterion for crisis response to road traffic incidents? What factors of hazard management are significant for improving response times?

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8b. What indicators or measures of performance do you think are important to apply?

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Logistics and Facilities

9a. What factors or mechanisms of logistics and facilities do you perceive to be vital to enhance road traffic crisis response times? Why do you think these factors are important?

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9b. What indicators or measures of performance do you think are important to apply?

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Public Education and Information

10a. What factors or processes of public education and information do you believe are critical for improving response times to road traffic crises? Why?

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10b. What indicators or measures of performance do you think are important to apply?

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Legal and Institutional Frameworks

11a. What processes or factors within legal and institutional frameworks do you think are critical to enhance road traffic crisis response times? Why do you think these factors are important?

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11b. What indicators or measures of performance do you think are important to apply?

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Recovery Initiation

12a. What processes or factors within recovery initiation do you perceive to be important for the optimisation of response times to road traffic crises? Why?

Recovery initiation focuses on the restoration of critical infrastructure, services and facilities following a road traffic crisis

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12b. What indicators or measures of performance do you think are important to apply?

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Operations and Procedures

13a. What processes or factors within operations and procedures do you believe are important to optimise response times for road traffic crises? Why?

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13b. What indicators or measures of performance do you think are important to apply?

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Early Warning

14a. How important do you think early warning systems are to road traffic crisis response? What factors, mechanisms or processes of early warning are significant for improving response times to road traffic crises?

Early warning systems provide relevant and timely information in an understandable way prior to a crisis or disaster enabling public and stakeholders to make an informed decision and take action

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14b. In your view what factors, mechanisms or processes of early warning are significant for improving response times to road traffic crises? Why?

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14c. What indicators or measures of performance do you think are important to apply?

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Property Protection

15a. Do you think property protection is an important criterion for enhancing road traffic crisis response times? What processes or factors in terms of property protection do you think are critical for improvement? Why?

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15b. What indicators or measures of performance do you think are important to apply?

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Crisis Leadership Development

16a. What processes or factor of crisis leadership development do you perceive to be critical for optimising road traffic crisis response times? Why?

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16b. What indicators or measures of performance do you think are important to apply?

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APPENDIX D – AHP INSTRUCTIONS

Instructions for the Analytic Hierarchy Process

The survey is designed to collect and analyse the judgements of key practitioners across different areas of law enforcement.

The goal is to rank and prioritise criteria, factors and measures of effectiveness that will support the development of the strategic framework for crisis readiness. The ranking process will use the Analytic Hierarchy Process (AHP). The criteria and factors under consideration are presented in Table 0-1. You will be asked to complete a number of matrices during the survey.

Completing the matrices will involve making simple comparisons on the importance of the criteria, factors or measures. The results will be used by the research team to generate weightings for criteria and indicators within each criterion.

Table 0-1 Framework of Criteria, Factors and Measures for Crisis Readiness

Goal	Criteria	Factors	Measures
Development of a Strategic Framework to Enhance Readiness of UAE Law Enforcement Agencies to Effectively Respond to Crisis Situations	Risk Assessment		
	Early Warning		
	Legal and Institutional Frameworks		
	Resources		
	Coordination		
	Information Management		
	Response Planning		
	Training		
	Crisis Leadership Development		
	Exercises		
	Logistics and Facilities		
	Public Education		
	Recovery Initiation		
	Hazard Management		
	Operations and Procedures		
	Property Protection		

Before you commence, an explanation of the AHP approach and instructions for completing the comparisons matrices are provided. This addresses what the Analytic Hierarchy Process is and how to use it.

What is the Analytic Hierarchy Process?

The Analytic Hierarchy Process (AHP) is a method for multi-criteria decision making. Initially developed by mathematician Saaty (1980) this tool has multiple and diverse applications in areas of planning and management. AHP uses a pairwise comparison method in which the importance or priority of two alternatives to achieving the goal are compared and assigned a numerical rating to generate weightings (ratio scales), rather than simply listing and ranking the levels of importance.

How is AHP conducted?

Step One: Construction of Pairwise Comparison Matrices

Pairwise comparisons are used to identify the relative importance of each criterion, and factor and measure associated with each criterion. The values available for the pairwise comparisons are members of the set: {9, 8, 7, 6, 5, 4, 3, 2, 1, 1/2, 1/3, 1/4, 1/5, 1/6, 1/7, 1/8, 1/9}. The pairwise comparisons are arranged in a matrix. The following section illustrates an example to demonstrate how to fill in the pairwise comparison matrix. Table 0-2 shows the scale for the pairwise comparisons.

Table 0-2 The Scale for Pairwise Comparisons

Note: Element ***a*** and ***b*** are any two of the criteria, factors or measures

Intensity of Importance	Definition	Explanation
1	Equal importance	Element ***a*** and ***b*** contribute equally to the objective
3	Moderate importance of one over another	Slightly prefer element ***a*** over ***b***
5	Essential importance	Strongly prefer element ***a*** over ***b***
7	Demonstrated importance	Element ***a*** is preferred very strongly over ***b***

9	Absolute importance	The evidence for preferring element ***a*** over ***b*** is of the highest possible order of importance
2, 4, 6, 8	Intermediate values between the two adjacent judgments	These are assigned when compromise is needed. For example, 6 can be used for the intermediate value between 5 and 7
1/3, 1/4, 1/5, 1/6, 1/7, 1/8, 1/9	These values represent the opposite of the reciprocal whole numbers. For example, if "9" means that ***a*** is much more important than ***b***, "1/9" means that ***a*** is much less important than ***b***.	

An Illustrative Example

In this example there are six criteria that could enhance the readiness of UAE law enforcement agencies to effectively respond to crisis situations: Risk Assessment; Resources; Coordination; Training; Response Planning

Pairwise comparisons are used to identify the priority and importance of these six criteria to enhancing crisis readiness. An empty template of the matrix is in Table 0-3. Participants need to compare these criteria using the blue cells as the baseline comparison with the green cells. In other words is the item in the blue cell more important, less important, or equal to the item in the green cell. Only the orange cells need to be filled with the evaluation. The white cells represent the reciprocal values of the associated orange cells. The grey cells are left blank as they map to the same criteria in both blue and green cells.

In the cell marked A in Table 0-3 the participant will need to decide if Risk Assessment is more important, as important, or less important than Resources. If it is judged that Risk Assessment is slightly more important than Resources a rating of 3 or 4 will be assigned in this cell. However if it is believed that Risk Assessment is slightly less important than Resources then ratings of 1/3 or 1/4 will be assigned in the cell.

The key point to remember is that the participant must fill in the orange cells by comparing the **importance or priority of the blue column to the green row**, and not the other way around.

Table 0-3 The Pairwise Comparison Matrix Template

Criteria	Risk Assessment	Resources	Coordination	Training	Response Planning
Risk Assessment		A			
Resources					
Coordination					
Training					
Response Planning					

Ranking Scale								
9	7	5	3	1	3	5	7	9
Absolutely More Important	Very Much More Important	Much More Important	Somewhat More Important	Equal Importance	Somewhat More Important	Much More Important	Very Much More Important	Absolutely More Important

Factor 1	9 Absolutely More Important	7 Very Much More Important	5 Much More Important	3 Somewhat More Important	1 Equal Importance	3 Somewhat More Important	5 Much More Important	7 Very Much More Important	9 Absolutely More Important	Factor 2
Factor 2	9 Absolutely More Important	7 Very Much More Important	5 Much More Important	3 Somewhat More Important	1 Equal Importance	3 Somewhat More Important	5 Much More Important	7 Very Much More Important	9 Absolutely More Important	Factor 3
Factor 1	9 Absolutely More Important	7 Very Much More Important	5 Much More Important	3 Somewhat More Important	1 Equal Importance	3 Somewhat More Important	5 Much More Important	7 Very Much More Important	9 Absolutely More Important	Factor 3