



**Prioritisation of Resilience Criteria and Performance Indicators for Road Emergencies Crisis Response: An Analytic Hierarchy Process (AHP) Approach**

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# Prioritisation of Resilience Criteria and Performance Indicators for Road Emergencies Crisis Response: An Analytic Hierarchy Process (AHP) Approach

## Introduction

Contemporary society is increasingly exposed to high levels of unpredictability, volatility and a multitude of risks that can result in significant human, physical, economic or environmental loss. Historical occurrences have consistently underlined the need for strong resilience and readiness capabilities to ensure the ability to effectively respond, alleviate and contain the impacts of crises or disaster events (Boin et al., 2016). Changes in the global ecological environment, human behaviour and rapid urbanisation have amplified and accelerated the gravity of events (Dranseika and Gordijn, 2018; Borraz and Cabane, 2017).

While many studies and models have addressed disaster management (Lettieri et al., 2009; Perry, 2007; Coppola, 2006), research into road emergency crisis readiness is scarce and less established. The economic consequences of the road traffic crisis are very significant, in terms of both lost productivity and all healthcare resources needed. This includes injuries and fatalities, property damage, workplace and household productivity losses, medical costs, traffic congestion and other costs. However, there is a gap in published research for a comprehensive crisis readiness and response framework that defines the critical success factors and performance indicators at a local or agency level. Thus, there is a need for the development of specific resilience indicators that will support the development and evaluation of crisis readiness.

This study is influenced by the problem context in the UAE, which has experienced an increase in road traffic crises in recent years triggered by increasing traffic and natural meteorological events such as fog and sand storms. 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 compared to 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. The UAE lags behind Western economies such as the UK, Germany and France, in terms of effectiveness of its road crisis response efforts.

The significance of crisis readiness and response is underscored by the increase and impact of road traffic globally. The costs to economies of road traffic incidents has risen to nearly 3% of annual gross domestic product (GDP), while over 90% of road traffic deaths occur in low and middle-income countries (WHO, 2020). The rapid development and urbanisation of developing countries such as the UAE lacking a mature regulatory framework, can have negative consequences for public health and economic productivity. For instance, response time for road traffic crises and emergencies for the UAE are significantly higher than benchmarks for global best practice. Average response times among major global cities in 2017 was 7:06 minutes for New York, 12 minutes for Singapore, and 14:44 minutes for London. In comparison, internal data from the Ministry of Interior shows that the response time in the UAE was 11.97 seconds, which represents a significant improvement over the 2016 response time of 13.16 (Moi, 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. A key strategy in optimising response times is focused on improving crisis readiness.

The issue of response is situated within broader internal and external factors that influence the

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2  
3 capacity for authorities to respond to traffic crises.  
4 In the UAE, recent responses to crises revealed  
5 that effective coordination is hampered by an  
6 absence of appropriate policies and mechanisms  
7 and understanding of how coordination can be  
8 optimised (Alteneiji, 2015). In particular  
9 enhancing coordination between federal and local  
10 levels during the management of disasters has  
11 been cited as a priority (Al-Marzooqi et al., 2017;  
12 Almarzouqi, 2017; Alteneiji, 2015). While NCEMA  
13 is the federal level authority charged with crisis  
14 management during disasters, some overlap has  
15 been noted in relation to how prevention,  
16 preparedness and recovery efforts are  
17 coordinated with the police force, which clearly  
18 assume a central role in leading responses and  
19 managing crises and disasters. Duplication of  
20 roles, communication gaps, and speed of response  
21 are identified as key challenges (Al-Marzooqi et  
22 al., 2017).

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27 Broader evaluation of the crisis response  
28 components and processes has been recognised  
29 as critical to enhancing the responsiveness of  
30 police to road traffic crises. This paper addresses a  
31 lack of research and understanding of the key  
32 dimensions and components of crisis readiness for  
33 road traffic incidents. Whereas crisis management  
34 and disaster resilience are recognised as major  
35 mechanisms to minimise the adverse impacts  
36 (Cutter et al., 2010), there is significant  
37 opportunity to develop specific indicators to  
38 support the advancement and evaluation of crisis  
39 readiness. Thus the central goal of this study is  
40 focused on enhancing the organisational  
41 effectiveness of law enforcement agencies within  
42 the United Arab Emirates (UAE) to effectively  
43 respond to crisis situations and disasters. This  
44 paper addresses this issue by conceptualising and  
45 validating a comprehensive strategic framework  
46 for crisis readiness that contributes a model to  
47 support readiness and response planning to  
48 improve police response times to road traffic  
49 crises.

## 56 Literature Review

57 While the notion of crisis readiness extends over a  
58 range of disciplines (WTTC, 2019) there is a lack of  
59 a universally accepted definition (Ritchie et al.,  
60

2011). It has been used interchangeably with  
preparedness and represents a key focus of this  
research. It has increasingly been adopted in the  
crisis management literature to reflect a specific  
state or phase in the process. In applying the  
concept of crisis readiness to this research  
context, the optimisation of 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).

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".  
Rousaki and Alcott (2006) define it as both a  
planned process of resource allocation and  
deployment, and also readiness in state of mind  
both at individual and organisational levels.

The characteristics of crisis readiness have been  
identified as a conscious and proactive orientation  
towards preparing for the inevitable occurrence of  
crises (Light and Morgan, 2008; Sheaffer and  
ManoNegrin, 2003). Light and Morgan (2008)  
emphasise that the organisational ability to  
effectively respond to and recover from major  
external events reflects the desired outcome of  
crisis management, organisational preparedness,  
business continuity planning and other  
organisational processes. 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. This understanding  
in turn provides the basis for the initiation and  
development of strategic plans and programmes.  
In an early conceptualisation of a crisis readiness  
construct, Reilly (1987) identified 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.

### ***Conceptualising Crisis Readiness***

As yet no comprehensive framework has been developed or validated in respect of crisis readiness dimensions and elements generally or in the specific context of road traffic crisis management. Thus the theoretical elements of crisis readiness are identified from an analysis of these theories and frameworks and models. In mapping the key dimensions and elements of crisis readiness fourteen distinct dimensions of crisis readiness were identified. A systematic search was conducted of social science journal databases guided by relevant keywords for the searches. The review integrated the key national models and institutional frameworks for disaster and crisis preparedness: Strategic Framework for Emergency Preparedness (WHO, 2017); Common Framework for Preparedness (CFP) by the Inter-Agency Standing Committee (IASC, 2013); The FEMA Capability Assessment for Readiness (CAR) framework (FEMA, 2001), and the national disaster emergency preparedness framework by Sutton and Tierney (2006). The databases searched were ProQuest, EBSCO, PsychINFO and Google Scholar. Further searches used Google to identify grey literature such as reports published by international bodies or government organisations. Initial screening was based on titles and abstract to shortlist studies and literature that addressed emergency, disaster or crisis themes focused on response, readiness and preparedness. Sources were then reviewed on the grounds of relevance to the research question, theoretical and methodological rigour (Anderson et al. 2001) and application in the practice. A total of 58 papers formed the basis of the conceptual framework proposed.

The literature points to several overarching principles drawn from crisis readiness frameworks and models that underpin crisis readiness planning and preparation: 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 (WHO, 2017; IASC, 2013; Sutton and Tierney, 2006).

In the USA 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 and measured using national level performance criteria. 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. A criticism of this however is the lack of integration of key elements of crisis readiness within the cycle including risk assessment, early warning, information and communication and public education. 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). The consult component addresses risk assessment and the embed component implementation processes: communication, governance, training and evaluation (CCA, 2004). The Australian framework is designed to address the significant variety of natural and non-natural hazards that the country faces (EMA, 2004). The model addresses the entire timeline of the crisis cycle that decomposes elements of readiness into specific activities which can be easily understood and implemented.

In addition to national models, a review of the literature identifies key crisis readiness frameworks, models and instruments that provide insights into principles and core components. Four of the prominent frameworks originate from international or national institutions and agencies responsible for crisis or emergency response, including FEMA's CAR model. 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 underpin 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 theoretical model advanced by Sutton and Tierney (2006) draws 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. This identified eight dimensions of preparedness for households, businesses and communities and organisations implemented as a continuous and proactive process that incorporates learning and broad engagement.

Similarly, broad engagement is a key theme in the Strategic Framework for Emergency Preparedness developed by the World Health Organisation (WHO). 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 (WHO, 2017).

### ***Key Dimensions of Crisis Readiness***

The conceptualisation of crisis readiness draws on the convergence in theory and praxis on key principles and elements. The literature points to multiple distinct but interrelated factors. Fourteen elements 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.

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 (WHO, 2017; IASC, 2013). There is consensus in the literature on the concept of community

participation in the risk assessment process specifically in supporting multi-hazard, multi-sectoral and multi-level risk and capacity assessments (WHO, 2017; Ikeda, 2010; Alexander, 2009; Nagasaka, 2006; CCA, 2004).

### **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. The features in most models address the preparedness of alert systems at a local, national, regional and international level (IASC, 2013).

### **Legal and Institutional Frameworks**

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). In the majority of frameworks, the legal and regulatory aspect is addressed in terms of the development and maintenance of emergency management programmes (WHO, 2017; IASC, 2013; FEMA, 2001). Recurring regulatory themes include crisis readiness legislation; integrated emergency preparedness; national plans and disaster authorities; cross-sectoral and sectoral frameworks; resource allocation, funding mechanisms, and regional and international agreements (WHO, 2017; IASC, 2013).

### **Resources**

Resources can have a major and direct influence on the ability of road traffic agencies to respond appropriately 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 (WHO, 2017; IASC, 2013; Sutton and Tierney, 2006; FEMA, 2001). Much of the discussion focused predominantly on the

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2  
3 availability and accessibility of financial, technical,  
4 and human resources. This dimension is identified  
5 as a key antecedent both in terms of building a  
6 state of crisis readiness and to support allocation  
7 and deployment of response teams, technical  
8 equipment, and other resources (WHO, 2017;  
9 Zemp, 2010; Light and Morgan, 2008; Hoffer Gittel  
10 et al., 2006; Kovoor-Misra, 1995).

### 13 **Coordination**

14 Coordination is a recurrent theme in the crisis  
15 readiness literature across all the models. Rapid  
16 response requires effective communication  
17 patterns and the coordination of resources,  
18 equipment, and skills to enable seamless  
19 collaborative action (Abbasi et al., 2018). This is  
20 characterised in terms of government  
21 coordination mechanisms, leadership structures  
22 and inter-agency coordination at all levels and  
23 across sectors (WHO, 2017; IASC, 2013).

### 27 **Information Management and 28 Communication**

29 Central to most models is the development of  
30 information management systems and  
31 communication systems at sector, national,  
32 regional and international levels for rapid  
33 dissemination of crisis communication in a timely  
34 response that minimises the impacts of the crisis.  
35 (Collins et al., 2016; IASC, 2013; FEMA, 2001). The  
36 literature converges around five key elements:  
37 communication systems; ICT technologies;  
38 information gathering and dissemination: data  
39 analysis and simulation tools; and communication  
40 response.

### 45 **Response Planning**

46 Response planning is represented in all the crisis  
47 preparedness models reviewed, associated with  
48 community preparedness, preparedness  
49 programmes and contingency planning (IASC,  
50 2013), risk assessment and optimisation of crisis  
51 response times (OECD, 2013). Key principles  
52 emphasise engagement of actors in the planning  
53 process and definition of key roles and  
54 responsibilities (OECD, 2013). Models emphasise  
55 learning and evaluation processes that  
56 incorporate continual learning and improvement  
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and feedback mechanisms (Kartez and Lindell,  
1987).

### **Training**

Training is recognised as one of the most pivotal  
factors in crisis readiness that can significantly  
contribute to lowering crisis response times  
(FEMA, 2015). 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  
including multi-stakeholders such as emergency  
volunteers (WHO, 2017; FEMA, 2015; Henstra,  
2010; Dillon et al., 2009). Key training elements  
address all-hazards planning, role-specific  
knowledge and skills, national context training  
opportunities, next generation core competencies  
(Feldmann-Jensen et al., 2017; Eriksson, 2015;  
IASC, 2013; EMAP, 2004; FEMA, 2001). 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 for strong calm leaders,  
communication, delegation, pragmatism and  
responsiveness (Cronin, 2015; Van Wart and  
Kapucu, 2011)

### **Exercises**

Exercises are recognised as a distinct dimension of  
training and preparedness (IASC, 2013; FEMA,  
2001) to develop familiarity and conditioning to  
crisis situations (OECD, 2013; Dillon et al. 2009;  
FEMA, 2001; Drennan et al., 2014). Existing  
models stipulate regularly scheduled simulations,  
drills and practical exercises for local, national  
and/or international actors (IASC, 2013; Sutton  
and Tierney, 2006; FEMA, 2001). Exercises are  
associated with a number of positive outcomes  
that enhance crisis readiness: enhancing cognitive  
sense-making abilities; revealing weaknesses, and  
providing data (Cronin, 2015; Lampel et al., 2009;  
Gordon, 2002) in crisis situations amongst all  
levels of staff (Cronin, 2015; OECD, 2013; Acosta  
et al., 2009).

### **Logistics and Facilities**

Logistics and facilities planning are reflected in all  
models and are addressed in relation to

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2  
3 contingency and standby arrangements for crises  
4 including stockpiling of resources and contingency  
5 partnership resource and supply agreements  
6 (IASC, 2013). Most frameworks emphasise the  
7 development of logistics capabilities and  
8 mechanisms which fall into four key categories of  
9 material management, property management,  
10 facility management and transportation  
11 management (WHO, 2017; Sutton and Tierney,  
12 2006; FEMA, 2001).

### 15 **Public Education**

16 Public education definitions emphasise a  
17 comprehensive process in which the public is  
18 informed and educated on crisis risks (Alexander,  
19 2012). Public education is considered in the  
20 majority of models that emphasise an effective  
21 public education programme on local or national  
22 hazards and risks to enhance community crisis  
23 preparedness (WHO, 2017; Sutton and Tierney,  
24 2006; FEMA, 2001).

### 28 **Hazard Management**

29 Hazards represent a unit of analysis and point of  
30 focus towards which all effort and resources for  
31 crisis readiness and response are directed.  
32 Hazards are defined as events, situations,  
33 processes or substances which are actual or  
34 potential sources of harm (NRC, 2006). The  
35 management of hazards is a component of crisis  
36 readiness in two of the models reviewed  
37 advocating a systematic approach to  
38 identification, assessment and mitigation of  
39 hazards posing significant threats (Sutton and  
40 Tierney, 2006; FEMA, 2001). The use of common  
41 crisis readiness functions that operate across all  
42 hazards boundaries is a key feature and includes  
43 functionalities such as: direction and control,  
44 warning and communication, continuity of  
45 government and operations, maintenance of  
46 essential public services, and resource  
47 management. The identification and assessment  
48 of hazards links to the risk assessment process in  
49 crisis readiness in much of the literature (WHO,  
50 2017; IASC, 2013). Nevertheless, Sutton and  
51 Tierney (2006) identify specific core features  
52 designed to lead to future mitigative actions  
53 including the conduct of hazard, impact and  
54 vulnerability assessments and detailed

understanding of the impacts on populations and  
facilities, structures, and infrastructure.

### 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.

### Recovery Initiation

The concept of recovery initiation was identified  
as a key component in half of the models (WHO,  
2017; Sutton and Tierney, 2006). Restoration of  
critical services and facilities such as utilities and  
transport are considered the basis for early  
recovery activities and containing further impacts  
(WHO, 2017; Sutton and Tierney, 2006).

### Property Protection

Property protection is identified by Sutton and  
Tierney (2006) in their systematic review as a  
further 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, to secure critical records  
and ensure the maintenance of critical functions  
during crises (Sutton and Tierney, 2006).

## Methodology

A single case study strategy was adopted based on  
a mixed method study to conceptualise and verify  
a framework for crisis readiness. The Delphi  
Method was employed 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. Online questionnaires will be the main methods used to collect different types of data at each stage to address the research goals.

The Analytical Hierarchical Process 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 allows the incorporation of objective and quantitative aspects as well as qualitative facets of complex problems to be reconstructed into a coherent decision-making model. Complex problems are broken down into defined hierarchies of categories and elements which are ranked by pairwise comparison to establish the priorities or preferences within each hierarchy. This provides a weighting for each category and element within a category as well as a consistency ratio which facilitates assessment of the consistency of the data (Saaty, 1978). The process can be applied to different complex problems with a variety of decision analyses, allowing decision-makers to identify and determine ratio scale priorities rather than assigning them arbitrarily (Richey and Grinnell, 2004).

**Table 1 Structure of Delphi Process**

	Method	Type	Analysis
Round 1	Open-Ended Questionnaire	Qualitative	Thematic Analysis
Round 2	Semi-structured Questionnaire	Qualitative-Quantitative	Thematic Analysis - Descriptive Analysis
Round 3	Pairwise Comparison	Quantitative	AHP Analysis
Round 4	Open-Ended Questionnaire	Qualitative	Thematic Analysis

In the first round of the Delphi process as indicated in Table 1 members completed an unstructured online questionnaire to collect qualitative data about what factors and key performance indicators for each of the fourteen crisis readiness criteria were important for improving road traffic

response times. In round two each Delphi participant was emailed a semi-structured questionnaire which integrated all the factors and measures generated from the first round. Participants reviewed and rated each criterion as well as their associated factors and performance measures using a Likert rating scale to denote perceived importance. In round three participants completed an Analytical Hierarchy Process form to derive the criteria, sub-criteria and key performance indicators evaluated as most important for optimising road traffic response times. The results from this round were then analysed and fed back to participants in the fourth and final round of the Delphi in which a final questionnaire was presented. This contained 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.

A total of 16 practitioners participated in the study sampled from UAE police forces, NCEMA, Civil Defence directorates, government and federal and local road transport authorities as shown in Table 2.

**Table 2 Participant Sample**

Sector	Organisation
Law Enforcement	Abu Dhabi Police Traffic and Patrols Directorate
	Dubai Police General Department of Traffic
	Dubai Police Department of Transport and Rescue
Civil Defence	Civil Defence General Command
	Civil Defence Fire and Rescue
	Dubai Civil Defence Directorate
	Abu Dhabi Civil Defence Directorate
Emergency and Crisis Management	NCEMA Planning and Preparedness Department
	NCEMA Operation Department
	NCEMA Local Centers Department
	NCEMA Information & Communication Technology Department
	NCEMA Safety and Prevention Department
Government	Ministry of Interior
	Federal Transport Authority – Land and Maritime



	Abu Dhabi Department of Transport
	Dubai Road Traffic Authority

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 involved in strategic and operational decision-making processes.

### **AHP Process**

The quantitative data from the AHP was analysed in a systematic manner in accordance with established procedures. These comprised four main steps: definition of hierarchical framework; calculation of pairwise comparisons; synthesis and calculation of judgements for prioritisation of weights; and evaluation of the consistency of the results (Al-Shehri et al., 2015; Cabala, 2010).

In the first step a hierarchical framework was defined that consisted of ten criteria for crisis readiness based on the literature review that pointed to the existence of fourteen key dimensions of crisis readiness. In earlier Delphi phases participants provided qualitative feedback on the key relative importance of these fourteen 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.

Pairwise comparisons were then calculated to evaluate the priority of the ten criteria. Members completed a matrix to indicate the relative priority or importance between items for achieving the goal (Cabala, 2010). The lesser or greater priority of each criteria against all of the others was assessed using a numerical nine-point scale.

The weights were then calculated from the pairwise comparisons to establish the priorities for all levels of the hierarchy: the ten criteria, sub-criteria and key performance indicators. The geometric mean was used to calculate and determine the priority weights for the individual pairwise comparisons. Then, the group priority weights were calculated by averaging the individual priority vectors using the weighted geometric mean (Dolan et al., 1989). All weights ranged in a scale between 0 and 1. Finally the results were evaluated for consistency using three key measures: consistency ratio, consistency index and the random index. To establish the consistency index (CI), the formula suggested by Saaty (1980) was used:

$$CI = \frac{\lambda_{max} - N}{n - 1} \quad (1)$$

Where  $\lambda_{max}$  is the maximum eigenvalue of the matrix of the importance ratios and  $n$  is the number of elements. The consistency ratio (CR) was calculated in order to determine if a pairwise comparison matrix was sufficiently consistent:

$$CR = \frac{CI}{RI} \quad (2)$$

This is calculated by using the ratio of the CI to the random index (RI). The RI is a consistency index of a matrix of randomly generated comparisons.

## **Results**

The main criteria of this research is composed of ten elements of crisis readiness: Risk and Hazard Management; Legal and Institutional Frameworks; Resources; Coordination; Information Management and Communication; Response Planning; Early Warning; Training; Recovery Initiation, and Property Protection. In addition to the main criteria, there are sub-criteria and key performance indicators for each criterion.

Analysis of the pairwise comparison for Crisis Readiness criteria shows that Response Planning was the highest ranked criterion with a relative weight of 0.173, followed by Resources (0.154) and Training (0.147). These top three criteria accounted for nearly half (47.4%) of the relative

weights. As shown in Table 3 the next highest ranked criteria were Coordination (0.141), Information Management and Communication (0.114) and Risk and Hazard Management (0.096). Early Warning and Legal and Institutional Frameworks were moderately prioritised with weights of 0.056 and 0.055 respectively. The lowest ranked criteria were Recovery Initiation and Property Protection with respective weights of 0.038 and 0.026. For each of the criteria the sub-criteria were evaluated to establish the relative importance of each item. It should be noted that due to practical limitations and time constraints the sub-criteria was only evaluated for the top six criteria of crisis readiness.

**Table 3 Prioritisation of Criteria**

Criteria	Weight	Rank
Response Planning	0.173	1
Resources	0.154	2
Training	0.147	3
Coordination	0.141	4
Information Management and Communication	0.114	5
Risk and Hazard Management	0.096	6
Early Warning	0.056	7
Legal and Institutional Framework	0.055	8
Recovery Initiation	0.038	9
Property Protection	0.026	10
<b>Consistency Measures</b> $\lambda_{\max} = 10.88$ ; CI=0.09; CR=0.06		

For Response Planning as shown in Table 4 equal prioritisation was given to joint response planning and resource planning with weights of 0.365. Roles and responsibilities ranked next with a weight of 0.172 while regular review and update was accorded the least priority of 0.099. Of the six sub-criteria for Resources, human resources, physical resources and logistics and facilities capabilities ranked the highest and were all equally prioritised with weights of 0.244. Weights for advanced technological resources,

maintenance of logistics systems and logistics planning ranged between 0.106 and 0.065. For the Training criterion continuous leadership development and field training ranked the highest with relative weights of 0.166 and 0.158 respectively. Exercises, technical training and equipment training were more moderately ranked with weights ranging between 0.123 and 0.113. The least prioritised items were theoretical training, inter-agency training and adoption/benchmarking of best practice with relative weights ranging between 0.104 and 0.03. Of the six sub-criteria for Coordination Operational Planning ranked the highest with a weight of 0.301, followed by Coordinated Operational Procedures (0.259) and Inter-agency Coordination (0.177). Relative weights for the remaining sub-criteria of joint training, centralised coordination systems and public coordination ranged between 0.114 and 0.052. For Information Management and Communication criterion, strategies and policies closely followed by advanced communication systems were the most prioritised with relative weights of 0.279 and 0.278 respectively. Public education and information programmes (0.133), multi-channel communications (0.110) and inter-agency communication (0.083) were ranked more moderately. For the lowest ranked sub-criteria of transfer of best practice, diverse communication forums and multiple incident reporting types priority weights ranged between 0.040 and 0.038. For Risk and Hazard Management the highest ranked sub-criteria was Risk and Hazard Analysis with a significant weight of 0.417. Hazard management planning, documenting risks and forecasting and modelling ranked next with weights ranging between 0.203 and 0.118. Hazard specific training had the least relative priority with a weight of 0.073.

Furthermore, key performance indicators (KPIs) were evaluated for the six most highly ranked criteria. For Response Planning coordinated planning processes received the highest relative weight of 0.564, followed by continuous planning (0.359) and qualified planners (0.077). Of the KPIs for Resources qualified human resource ratios ranked highest with a weight of 0.415, one of the

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2  
3 highest of any performance indicator. For the  
4 remaining KPIs of funding availability, technical  
5 resources availability, facilities and equipment  
6 availability and periodic review and maintenance  
7 relative weights ranged between 0.271 and 0.041.  
8 For Training continuous training (0.198), training  
9 modes implemented (0.162), and frequency and  
10 types of exercises (0.160) were the most highly  
11 prioritised KPIs. Training evaluation and training  
12 and capacity standards were more moderately  
13 ranked with relative weights of 0.155 and 0.117  
14 respectively.  
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Table 4 Prioritisation of Sub-Criteria

Criteria	Sub-Criteria	Weight	Rank	Consistency
<b>Response Planning</b>	Joint Response Planning	0.365	1	$\lambda_{\max} = 4.19$ ; CI=0.06; CR=0.07
	Resource Planning	0.365	2	
	Roles and Responsibilities	0.172	3	
	Regular Review and Update	0.99	4	
<b>Resources</b>	Human Resources	0.244	1	$\lambda_{\max} = 6.25$ ; CI=0.05; CR=0.04
	Physical Resources	0.244	2	
	Logistics and Facilities Capabilities	0.244	3	
	Advanced Technological Resources	0.106	4	
	Maintenance of Logistics Systems	0.096	5	
	Logistics Planning	0.065	6	
<b>Training</b>	Continuous Leadership Development	0.166	1	$\lambda_{\max} = 11.31$ ; CI=0.14; CR=0.09
	Field Training	0.158	2	
	Exercises	0.123	3	
	Technological Training	0.116	4	
	Equipment Training	0.113	5	
	Theoretical Training	0.104	6	
	Inter-agency Exercises	0.094	7	
	Virtual Simulations	0.057	8	
	Database of Resources & Capacities	0.037	9	
	Benchmarking Best Practices	0.030	10	
<b>Coordination</b>	Operational Planning	0.301	1	$\lambda_{\max} = 6.47$ ; CI=0.09; CR=0.07
	Coordinated Operational Procedures	0.259	2	
	Interagency Coordination	0.177	3	
	Joint Training	0.114	4	
	Centralised Coordination Systems	0.098	5	
	Public Coordination	0.052	6	
<b>Risk &amp; Hazard Management</b>	Risk and Hazard Analysis	0.417	1	$\lambda_{\max} = 5.35$ ; CI=0.08; CR=0.08
	Hazard Management Planning	0.203	2	
	Documenting Risks	0.188	3	
	Forecasting and Modelling	0.118	4	
	Hazard Specific Training	0.073	5	
<b>Information Management &amp; Communication</b>	Strategies and Policies	0.279	1	$\lambda_{\max} = 8.85$ ; CI=0.12; CR=0.08
	Advanced Communication Systems	0.278	2	
	Public Education & Information	0.133	3	
	Multi-channel Communications	0.011	4	
	Inter-agency Communication	0.083	5	
	Transfer of Best Practice	0.040	6	
	Diverse Communication Forums	0.039	7	
	Multiple Incident Reporting Types	0.038	8	

Table 5 Rankings for Performance Indicators

Criteria	Sub-Criteria	Weight	Rank	Consistency
<b>Response Planning</b>	Coordinated Planning Processes	0.564	1	$\lambda_{\max} = 3.07$ ; CI=0.03; CR=0.06
	Continuous Planning	0.359	2	
	Qualified Planners	0.077	3	
<b>Resources</b>	Qualified Human Resource Ratios	0.415	1	$\lambda_{\max} = 5.38$ ; CI=0.09; CR=0.08
	Funding Availability	0.271	2	
	Technical Resources Availability	0.137	3	
	Facilities and Equipment Availability	0.137	4	
	Periodic Review and Maintenance	0.041	5	
<b>Training</b>	Continuous Training	0.198	1	$\lambda_{\max} = 9.83$ ; CI=0.10; CR=0.07
	Training Modes Implemented	0.162	2	
	Frequency and types of exercises	0.16	3	
	Training Evaluation	0.155	4	
	Training and Capacity Standards	0.117	5	
	Ratio of Accredited Training Programmes	0.061	6	
	Number of Training Courses Implemented	0.056	7	
	Multi-hazard Capacity Assessment	0.054	8	
	Use of Virtual, AI and simulation technologies	0.037	9	
<b>Coordination</b>	Equipped Operations Centres	0.241	1	$\lambda_{\max} = 6.47$ ; CI=0.09; CR=0.07
	Crisis Appropriate Operational Protocols	0.213	2	
	Information Exchange Mechanisms	0.181	3	
	Inter-agency Coordination Mechanisms	0.159	4	
	Defined Roles & Responsibilities	0.013	5	
	Public & Community Coordination Mechanisms	0.076	6	
<b>Information Management and Communication</b>	Incident Report Communication time response teams	0.428	1	$\lambda_{\max} = 7.78$ ; CI=0.13; CR=0.09
	Number of Information & Reporting Mechanisms	0.153	2	
	Smart Application Use in Incident Reporting	0.121	3	
	Multilingual Communication Mechanisms	0.121	4	
	Public Information Programmes Implemented	0.083	5	
	Data Collection Mechanisms	0.064	6	
	Trained Media Response Units	0.031	7	
<b>Risk and Hazard Management</b>	Continuous Hazard and Risk Monitoring	0.288	1	$\lambda_{\max} = 5.37$ ; CI=0.09; CR=0.08
	All Hazards Risk Register	0.260	2	
	Risk Communication Plan	0.239	3	
	Plans for Specific Risks	0.164	4	
	Frequency Risk Register Reviewed;	0.049	5	

As shown in Table 5 the least prioritised KPIs were ratio of accredited training programmes, number of training courses implemented, multi-hazard capacity assessment and use of virtual, AI and simulation technologies with relative weights ranging between 0.061 to 0.037. Coordination equipped operations centres ranked highest (0.241), followed by crisis appropriate operational protocols (0.213) and information exchange mechanisms (0.181). Inter-agency coordination mechanisms, defined roles and responsibilities and public and community coordination mechanisms were next prioritised with weights ranging between 0.159 and 0.076. For Information Management and Communication criterion communication time to response teams recorded a relative weight of 0.428, the highest priority accorded to any performance indicator. Number of information and reporting mechanisms (0.153), smart application use in incident reporting (0.121), and multilingual communication mechanisms (0.121) ranked next in importance. Public information programmes implemented, data collection mechanisms and trained media response units were prioritised as least important with relative weights ranging between 0.083 to 0.031. For Risk and Hazard Management continuous hazard and risk monitoring ranked highest with a weight of 0.288, while all hazards risk register, risk communication plan and frequency risk register reviewed relative weights ranged between 0.260 and 0.049. The consensus responses conformed with acceptable requirements for the Consistency Ratio.

## Discussion

The findings resulted in the ranking of the ten criteria that were identified for crisis readiness and response. Four criteria of Response Planning, Resources, Training, and Coordination were assigned the highest importance by practitioners. The AHP priority weights 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 (WHO, 2017; IASC, 2013; Sutton and Tierney, 2006; FEMA, 2001).

Response planning was the mostly highly ranked criterion overall but was only marginally prioritised over the other three top ranked criteria. While the majority of crisis readiness frameworks do not explicitly prioritise this criterion over others, all frameworks incorporate response planning as a core dimension (WHO, 2017; IASC, 2013; Sutton and Tierney, 2006; FEMA, 2001). 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 (Berchtold et al., 2020; Quarantelli, 1998). 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 (Ginter et al., 2006; Corbacioglu and Kapucu, 2005; Tierney, 2003). There is an implication towards development of open and autonomous cultures for countries such as the UAE where the national culture is characterised by high power distance and uncertainty avoidance (Hofstede, 2019).

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 (WHO, 2017; IASC, 2013; Sutton and Tierney, 2006; FEMA, 2001). However the

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3 literature emphasises extending beyond generic  
4 and simplified strategies to address the major  
5 resource constraints and competition that are  
6 typically experienced. This has implications for  
7 more advanced techniques for integration and  
8 optimisation of redundancy and resource-sharing  
9 based on more complex analyses. This is  
10 consistent with an interdependent and multi-  
11 faceted dimension in crisis response associated  
12 with a range of different issues and factors (Wang  
13 and Sun, 2018; Hick et al., 2012; Simonoff et al.,  
14 2011). There are further implications for ensuring  
15 the efficient, fair and timely allocation of scarce  
16 resources that can account for specific crises and  
17 conditions (Choksi and Zaveri, 2019; Alsubaie et  
18 al., 2015). Evidence suggests that efficient  
19 resource allocation practice is increasingly  
20 evolving towards in-time and real-time techniques  
21 based on technology solutions such as RFID  
22 tagging, virtual simulation and resource  
23 management algorithms that prioritise and  
24 schedule resources (Choksi and Zaveri, 2019). An  
25 overarching challenge is the identification of  
26 antecedents including culture such as power that  
27 may influence cooperation inter-organisationally  
28 to promote optimisation and sharing of resources.

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35 Panel members prioritised training as the third  
36 most important criterion for crisis readiness. This  
37 aligns with literature on the role of training as a  
38 key issue that directly impacts the ability of crisis  
39 response organisations to mount an effective  
40 response (Hošková-Mayerová, 2016; Bui and  
41 Subba, 2009). Training is cited in all of the crisis  
42 readiness frameworks reviewed for this study,  
43 although only the FEMA (2001) and IASC (2013)  
44 framework explicitly identify this criterion as a  
45 separate, discrete aspect. A key factor is the  
46 coordination of training between regions and  
47 agencies (Berchtold et al., 2017).

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51 There is a major implication in defining key roles,  
52 structures and processes to account for diverse  
53 and specific training needs across an array of  
54 functions, roles and levels as well as intra and  
55 inter-organisational contexts and requirements  
56 (Adini et al., 2016; Leaning et al., 2013). While  
57 operational and tactical training is well  
58 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  
(Adini et al., 2016; Hsu et al., 2013).

Co-ordination was the fourth highest prioritised  
criterion and comparable to training. This finding  
lends support to the theoretical emphasis found in  
the literature as one of the principal elements  
directly connected to crisis readiness and crisis  
management during response and relief processes  
(Noori et al., 2016; Abbasi et al., 2013; Chen et al.,  
2008). 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 (WHO, 2017;  
IASC, 2013; Sutton and Tierney, 2006; FEMA,  
2001). The Common Framework for Preparedness  
(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  
coordination mechanisms and procedures. The  
design of coordination mechanisms is dependent  
on overcoming differences in the organisational  
culture and therefore understanding of specific  
barriers and impediments in a particular context.  
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., 2016;  
Christensen et al., 2015). This suggests that  
countries such as the UAE need to develop the  
necessary conditions that can promote trust and  
cooperation. Arabic organisations are  
characterised by clandestineness, power  
dynamics, secrecy and closed, top-down cultures  
which may create challenges for development of

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3 coordination. To develop effective coordination  
4 for crisis readiness therefore has some implication  
5 for addressing cultural issues (Christensen et al.,  
6 2016).

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8 Information Management and Communication  
9 (ICM) and Risk and Hazard Management received  
10 more moderate prioritisation in ratings and were  
11 the fifth and sixth highest criteria in terms of  
12 importance. The ICM dimension was identified as  
13 a key component of all the crisis readiness  
14 frameworks reviewed. The literature consistently  
15 shows consensus on the importance of rapid and  
16 accurate information gathering and dissemination  
17 to relevant actors and the public to mitigate the  
18 worst effects of crises and disasters (Sokat et al.,  
19 2016; OCHA, 2016).

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

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35 Examination of the existing frameworks indicates  
36 that these criteria are addressed to varying  
37 degrees with differing levels of detail. The Early  
38 Warning criteria is explicitly identified across all of  
39 the frameworks which specify necessary  
40 attributes and provide guidelines for effective  
41 early warning systems. Predominantly it is  
42 characterised as a key component of other criteria  
43 in the frameworks such as Resources (CP model)  
44 or Information Management (SFEP) (WHO, 2017;  
45 IASC, 2013; Sutton and Tierney, 2006; FEMA,  
46 2001). Within the broader crisis readiness  
47 literature there is limited evidence of a specific  
48 research focus on early warning (Collins et al.,  
49 2008). Rather early warning has often been  
50 discussed within the context of overall hazard  
51 monitoring and forecasting (Hense et al., 2010;  
52 Singh and Subramaniam, 2009).

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 (WHO,  
2017; IASC, 2013; FEMA, 2001).

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).

A further 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 AHP 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. 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



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3 can be integrated in existing crisis response plans  
4 to guide evaluation.  
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## 6 **Conclusion**

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

21 The purpose of this study has been to investigate  
22 crisis readiness and response of Police in the UAE  
23 and establish the key dimensions that contribute  
24 to a comprehensive strategic framework that  
25 supports readiness and response planning to  
26 improve Police response times to road traffic  
27 crises. The qualitative and quantitative research  
28 conducted in this study provided primary data to  
29 identify and validate the key dimensions for crisis  
30 readiness. Findings from initial rounds of the  
31 Delphi process showed that of fourteen  
32 theoretical dimensions derived from theory and  
33 literature experts identified the top ten most  
34 critical components of crisis readiness. These  
35 criteria were then subject to an Analytical  
36 Hierarchy Process (AHP) in which the relative  
37 prioritisation and ranking of these criteria were  
38 identified. The results clustered into three distinct  
39 sets of ranking: four criteria of Response Planning,  
40 Resources, Training, and Coordination received  
41 the highest level of priority by the panel;  
42 Information Management and Communication  
43 and Risk and Hazard Assessment were ranked at  
44 mid-level importance. The remaining four criteria  
45 were accorded a lower level of priority: Early  
46 Warning, Legal and Institutional Frameworks,  
47 Recovery Initiation and Property Protection.

48 Qualitative findings further indicated a broad  
49 range of factors for each criterion proposed by  
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practitioners. In a second phase of AHP experts  
were able to identify the relative importance of  
the sub-criteria for each of the top six criteria.  
These findings provide validation for the key  
criteria established in the literature and CR  
frameworks and the relative priority of different  
factors and sub-criteria. Furthermore, qualitative  
data suggests a strong relationship and  
interdependency between different criteria and  
factors in this study. 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.

This research makes several contributions to  
theory and praxis in identifying the key  
dimensions and factors of crisis management and  
response. This research 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 analytical hierarchy process  
(AHP) approach. This has resulted in a novel  
framework that comprehensively addresses the  
key dimensions and factors of crisis readiness and  
provides a holistic model. Criteria and sub-criteria  
and key performance indicators for each criterion  
are ranked in order of priority and relative  
importance. This ranking can support the  
clarification of achievements and support  
identification of gaps and monitoring of factors  
and specific elements of crisis readiness. The  
framework supports practitioners as a  
management tool that supports strategic planning  
and decision-making for the development of  
organisational capacities that can enhance  
response times of police to road traffic crises. At  
the same they provide focus for further research  
into the impact of KPIs on the performance of  
crisis response agencies and institutions and  
programmes so that sub-elements can be  
identified and more closely aligned to critical

processes. 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. The findings have implications for organisational practice to ensure that these elements are fully represented in crisis readiness plans. This can promote an alignment of measures on critical dimensions of crisis response and inform development of key roles, structures and processes specific to each area of priority.

The limitation of this study should be acknowledged. 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. Contribution to this field can be expanded with further research in several areas. A key focus for future research could be to explore and validate the framework criteria and factors 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 relevance and applicability for a wider group of actors and agencies. Knowledge can also be advanced with research and validation of key performance indicators according to specific criteria and sub-criteria as well as understanding the relationship between different criteria.

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