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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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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

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2
3 human rights norms and which underpin the
4 operationalisation of the framework. The model
5 provides a systematic approach based on eight key
6 components to collectively assess capabilities and
7 needs and develop and implement programmes
8 and plans to enhance preparedness.
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10 A theoretical model advanced by Sutton and
11 Tierney (2006) draws on a systematic review of
12 diverse practitioner, government and academic
13 sources on preparedness and planning including
14 research instruments, preparedness guidance and
15 checklists, guidance from federal agencies, best
16 practices, and scholarly and business journals.
17 This identified eight dimensions of preparedness
18 for households, businesses and communities and
19 organisations implemented as a continuous and
20 proactive process that incorporates learning and
21 broad engagement.
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26 Similarly, broad engagement is a key theme in the
27 Strategic Framework for Emergency Preparedness
28 developed by the World Health Organisation
29 (WHO). This is based on strong principles of
30 political and community engagement and
31 commitment. Key elements grouped around
32 three main areas of governance, capacities and
33 resources support the determination of priorities
34 and the strengthening of operational capacities
35 (WHO, 2017).
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37

38 ***Key Dimensions of Crisis Readiness***

39 The conceptualisation of crisis readiness draws on
40 the convergence in theory and praxis on key
41 principles and elements. The literature points to
42 multiple distinct but interrelated factors. Fourteen
43 elements have been identified which are
44 integrated into a comprehensive conceptual
45 framework that guides the development of a crisis
46 readiness framework. These elements have been
47 drawn from models and frameworks from
48 different contexts and sectors.
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52 Risk assessment is common to all the frameworks
53 and focuses on identification and evaluation of
54 hazards and risks, vulnerabilities, and capacities to
55 determine priorities for emergency preparedness
56 (WHO, 2017; IASC, 2013). There is consensus in
57 the literature on the concept of community
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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

1
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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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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 λ_{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
Consistency Measures $\lambda_{\max} = 10.88$; 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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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
Response Planning	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	
Resources	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	
Training	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	
Coordination	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	
Risk & Hazard Management	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	
Information Management & Communication	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
Response Planning	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	
Resources	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	
Training	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	
Coordination	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	
Information Management and Communication	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	
Risk and Hazard Management	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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