

**Enhancing Disaster Risk Reduction and Response:
A Comparison of the Complexities of Inter-Sectoral Coordination in the
Omani Disaster Management System 2010-2020**

Faisal Salim AL Hajri

A thesis submitted in partial fulfilment of the requirements of Bournemouth University for
the degree of Doctor of Philosophy

December 2023

Bournemouth University

Copyright Statement

“This copy of the thesis has been supplied on condition that anyone who consults it is understood to recognise that its copyright rests with its author and due acknowledgement must always be made of the use of any material contained in, or derived from, this thesis.”

Abstract

Oman's knowledge of its vulnerability to natural hazard-induced disasters has significantly increased after the two severe cyclones in 2007 and 2010, which were both unprecedented. Despite this, awareness of its history of emergency management is inconsistent. Thus, Disaster risk reduction and response are critical components of ensuring the safety and resilience of communities and societies. The coordination and collaboration across many sectors and organisations involved in disaster management are crucial to the success of these efforts. This study explores the challenges of inter-sectoral coordination within the Omani Disaster Management System (ODMS) from 2010 to 2020 to pinpoint areas for development and alternative approaches to improve disaster management results.

In the aftermath of the 2010 disaster, a new system was developed, embracing regional and global emergency management best practices whilst also accommodating the lessons learned from the cyclones Gonu (2007) and Phet (2010). However, this thesis used Social Network Analysis (SNA) and qualitative research methods to investigate how inter-sectoral coordination operates, identify all the relevant Oman DMS components, develop a framework for assessing the Oman DMS, and how effective it is in the post-2010 Omani disaster management system. This methodological approach was achieved by using a conceptual framework designed to provide insights on how to enhance and improve the post-2010 Omani disaster management system. This thesis emphasises the significance of social network theory for the implementation of novel strategies to support inter-sectoral agencies, such as improving communication channels, encouraging information sharing, and forming inter-sector partnerships.

This thesis' main findings highlight that while Oman's post-2010 disaster management system has made substantial progress in enhancing emergency management and features a strong coordination structure during response network operations, risk reduction requires even greater development to improve the effectiveness of disaster management operations. Unfortunately, current weaknesses in risk reduction have reduced overall effectiveness as well as prevented prompt and efficient provision of vital services during disaster situations.

The findings – drawing on a detailed analysis of policy documents, reports, and expert interviews - reveal that there are numerous challenges faced by different organisations in the disaster management sector, including governmental agencies, non-governmental organisations, and private stakeholders. The study further shows that inter-sectoral coordination is an effective response in addressing a complex disaster management system, can

help to ensure successful outcomes in the immediate operation, and offers proactive measures in the short-term and long-term. Additionally, the finding identified the importance of using inter-sectoral concepts in multisectoral and interdisciplinary organisations performing various roles to achieve the same objective and goal of enhancing and delivering essential services to society.

Ultimately, this research provides a framework for decision-makers, practitioners, and stakeholders in Oman's disaster management sector to understand, assess, and improve their approaches, facilitating a coordinated effort to improve disaster risk reduction and response capabilities in the face of changing threats. Moreover, this thesis adds value to existing academic knowledge. In particular, it contributes to advancing research into social networks as a conceptual framework in social sciences, particularly for the study of inter-sectoral cooperation/coordination and clusters/sectors.

Table of Contents

Copyright Statement	1
Abstract	2
Acknowledgements	13
Author’s Declaration	14
Chapter 1 Introduction	15
1.1 Aim	21
1.2 Objectives	21
1.3 Research Questions.....	22
1.4 Contribution.....	22
1.5 Structure of Thesis.....	24
Chapter 2 Literature Review	27
2.1 Inter-Sectoral coordination in Omani’s Disaster Management System	27
2.2 Development of Effective Inter-Organisational Disaster Management Systems.....	28
2.3 Operationalization of Disaster Risk Reduction (DRR)	30
2.3.1 Stage 1: Risk Reduction/Mitigation.....	31
2.3.2 Stage 2: Preparedness	32
2.3.3 Stage 3: Response	32
2.3.4 Stage 4: Recovery	33
2.4 Complexity of Disasters	34
2.5 Framework of Complexity of Disasters.....	35
2.5.1. Complex Adaptive Systems	35
2.6 Social Network Theory.....	39
2.6.1 Relevance of Social Network Approach in Management.....	41
2.6.2 Resilience and Organisational Resilience Theory	42
2.6.3 Social Network Research Approaches.....	42
2.6.4 Network Analytical Approach	47
2.7 Network Governance	49
2.8 Types of Network Governance	50
2.8.1 Network Legitimacy	50
2.8.2 Network Accountability.....	51
2.8.3 Network Leadership.....	52
2.9 Forms of Network Governance	52

2.10 Management Activities in Network.....	53
2.11 The Concept of Coordination	53
2.11.1 Overview of Coordination Theory.....	54
2.11.2 Conditions for Coordination	55
2.11.3 Coordinating Mechanisms	56
2.12 Inter-Sectoral Coordination in Emergency Management Systems.....	58
2.12.1 The Role of Collaboration in Inter-Sectoral Coordination	59
2.12.2 Implementation and Practices of Inter-Sectoral Coordination.....	61
2.13 Conclusion of Literature Review	62
Chapter 3 Conceptual Framework.....	64
3.1 Significance of Conceptual Framework	64
3.2 Social Network Theory.....	67
3.3. Identifying Features and Benchmarks of the Three Dimensions Applicable in the Oman Management System.....	68
3.4 The first Lens: Network Characteristics	70
3.4.1 Density	70
3.4.2 Centralization.....	71
3.4.3 Centrality.....	71
3.4.4 Core-periphery	72
3.5 The Second Lens: Network Governance	73
3.5.1 Legitimacy	73
3.5.2 Accountability.....	73
3.5.3 Leadership & Management.....	74
3.6 The Third Lens: Network Collaborative Functions.....	74
3.6.1 A template for inter-sectoral coordination	75
3.6.2 Benchmarks.....	76
3.7 Conclusion	79
Chapter 4 Methodology	82
4.1. Types of Research Approaches	83
4.1.1. Interpretative Approach	83
4.1.2. Descriptive Approach	85
4.2. Methods	85
4.2.1. Semi-structured Interviews	86
4.2.2. Document Review.....	87

4.2.3 Benefits of Documents.....	87
4.3. Sampling Techniques	89
4.3.1. Sample Characteristics.....	92
4.4 Data Collection	95
4.4.1 Understanding the Omani Emergency Management System	95
4.4.2 Pilot Interviews	96
4.4.3 Logistical Arrangements.....	96
4.4.4 The Interview Process.....	97
4.4.5 Post-Interview Process: Transcription and coding	98
4.5 Data Analysis.....	100
4.5.1 Thematic Analysis of Data.....	102
4.5.2. Validity and Reliability	105
4.5.3. Ethics, Health, and Safety	106
4.6. Conclusion.....	107
Chapter 5 Findings and Discussion 1	108
5.1 Overview of the Omani Emergency Management System	108
5.2 NDMS Response to Oman’s Vulnerability to Disasters	108
5.3 The Omani Emergency Management Approach	109
5.4 Oman Emergency Management Structure.....	112
5.4.1 National Committee for Emergency Management (NCEM)	113
5.4.2 The National Emergency Management Centre (NEMC).....	115
5.4.3. Governorates Emergency Management Committees.....	115
5.4.4 Wilayats (Local) Emergency Management Committees	115
5.5 Sectors	116
5.5.1 Early Warning Sector (EWS).....	118
5.5.2 Media and Public Awareness Sector (MPAS)	118
5.5.3 Medical Response and Public Health Sector (MR & PH)	119
5.5.4 Relief and Shelter Sector (R&SS).....	119
5.5.5 Search and Rescue Sector (S&R)	120
5.5.6 Critical Infrastructure Sector (CIS).....	120
5.5.7 HAZMAT Sector	121
5.5.8 Victims Affairs Sector (VAS).....	121
5.6 Analysis of the Omani Emergency Management Network	122
5.6.1 Density	126

5.6.2 Centralization.....	126
5.6.3 Centrality Measures	127
5.7 Conclusion.....	131
Chapter 6 Findings and Discussion 2.....	133
6.1 Response Network.....	133
6.2 Response Network Governance.....	134
6.2.1 Legitimacy	134
6.2.2. Accountability.....	136
6.2.3. Leadership and Management	139
6.3 Response Network Coordination and Collaborative Functions	141
6.4 The Response Network Coordination System.....	142
6.4.1 Response Coordination at the National Level	143
6.4.2 Response Coordination at the Governorate Level	145
6.4.3 Response Coordination at Wilayat Level	147
6.5 Response Network Collaborative Functions	149
6.5.1 Planning and Decision Making.....	149
6.5.2 Capacity Building	153
6.5.3 Resource Sharing	155
6.5.4 Information sharing.....	157
6.5.5 Joint actions	159
6.6 Response Coordination Issues and Challenges	161
6.7 Response Network Characteristics	163
6.7.1 Density	166
6.7.2 Centralization.....	167
6.7.3 Centrality Measures	167
6.7.4 Response Network Vs. Emergency Management System Network.....	170
6.8 Conclusion.....	171
Chapter 7 Findings and Discussion 3.....	175
7.1 Disaster Risk Reduction Network	175
7.2 Oman Disaster Risk Reduction Approach.....	175
7.3. Risk Reduction Network Governance	177
7.3.1 Legitimacy in the Risk Reduction Network.....	177
7.3.2 Accountability in Risk Reduction Network.....	180
7.3.3 Leadership and Management in Risk Reduction Network	184

7.4 Risk Reduction Network Coordination and Collaborative Functions	186
7.4.1 The Risk Reduction Coordination System.....	186
7.4.2. Risk Reduction Coordination Functions	189
7.4.3 Planning and Decision Making	189
7.4.4 Information Sharing	190
7.4.5 Capacity Building	191
7.4.6 Resources Sharing.....	192
7.5 Risk Reduction Network Structure and Characteristics	194
7.5.1 Risk Reduction Network Density	196
7.5.2 Risk Reduction Network Centralization	196
7.5.3 Risk Reduction Network Centrality Measures	197
7.6 Risk Reduction Network Vs. Emergency Management System Network	199
7.7 Conclusion on Disaster Risk Reduction Network	201
Chapter 8 Discussion of Findings and Results	204
8.1 Response Network Vs Risk Reduction Network.....	204
8.2 Governance.....	205
8.3 Organisational Structure	207
8.4 Accountability	208
8.4.1 Policy and Plans.....	210
8.5 Coordination Functions	213
8.5.1 Intersectoral Coordination	213
8.6 Sectors	217
8.6.1 Sector Performance	218
8.6.2 Critical Infrastructure Sector.....	218
8.6.3 Early Warning Sector.....	219
8.6.4 Media and Public Awareness Sector (MPAS)	221
8.6.5 Medical Response and Public Health (MR & PH) Sector	223
8.7 Network Analysis	224
8.8 Conclusion on the Response Vs Risk Reduction Networks	227
8.9 Conclusion on the Discussion of Findings and Results.....	231
Chapter 9 General Conclusion	234
9.1 Review of Research Objectives	234
9.1.1 Objective One	234
9.1.2 Objective Two.....	237

9.1.3 Objective Three.....	241
9.2 Limitations.....	244
9.3 Contributions	245
9.4 Future Research Agenda.....	247
References.....	249
Appendix 1: Thesis Findings Summary Table	272
Appendix 2: Interview Questions	283
Appendix 3: Transcript of one of the Interviews Conducted	287
Appendix 4: Sample of a Document Reviewed.....	300
Appendix 5: Abbreviations of the Oman Emergency Management System	301

List of Figures

Figure 1: Shows Disaster Management Cycle (Coppola 2011).....	31
Figure 2: Conceptual Framework (Author 2022)	67
Figure 3: Three Perspectives/Lenses of the Research Conceptual Framework (Author 2022)	69
Figure 4: Research Methodology (Author 2022).....	89
Figure 5: Map of Oman identifying the Governorates (World Atlas 2023)	94
Figure 6: Data Collection Process (Author 2022)	100
Figure 7: NDMS Structure and Inter-Relationships of Committees and Sectors (NEMP 2018)	113
Figure 8: Graphical Representation of the Omani Emergency Management System (Hagberg et al. 2018)	125
Figure 9: Omani Emergency Management System Network (Bastian et al. 2009).....	125
Figure 10: Brokers of NEMP Network (Hagberg et al. 2008).....	129
Figure 11: Lenses of Response Network Analysis (Author 2022)	133
Figure 12: Response Network Collaborative Functions (Author 2022).....	142
Figure 13: Response Network Coordination Structure at the National Level (NEMP 2018)	145
Figure 14: Response Network Coordination Structure at the Governorate and Wilayat Levels (NEMP 2018).....	147
Figure 15: Response Network Coordination Structure (NEMP 2018).....	148
Figure 16: Graphical Representation of the Oman Response Network (Hagberg et al. 2008)	165
Figure 17: Graphical Representation of the Oman Response Network (Bastian et al. 2009)	166
Figure 18: Brokers in the Response Network (Bastian et al. 2009)	169
Figure 19: Response Network.....	170
Figure 20: Formal Emergency Management System	170
Figure 21: Disaster Risk Reduction Network Assessment Framework (Author 2022).....	175
Figure 22: Risk reduction network according to the NEMP (NEMP 2018).....	188
Figure 23: Graphical representation of the Omani Risk Reduction Network (Hagberg et al. 2008)	195
Figure 24: Graphical Representation of the Omani Risk Reduction Network (Bastian et al. 2009)	196

Figure 25: Brokers of the Risk Reduction Network (Bastian et al. 2009).....	199
Figure 26: Risk reduction network (Hagberg et al. 2008)	200
Figure 27: Formal emergency management plan (Hagberg et al. 2008)	200
Figure 28: Response Network and Risk Reduction Network (Bastian et al. 2009).....	225
Figure 29: Three-Dimension Conceptual Framework Used to Assess the Effectiveness of Intersectoral Coordination in Oman Post 2010 Disaster Management Systems (author 2022)	237

List of Tables

Table 1: Cyclones that Hit Oman and their Effects (NCEM 2021)	17
Table 2: A summary of the research's aims, objectives, methodologies, and questions (Author 2022).....	23
Table 3: Main Features of the Dimensions Approach to Disaster Management in Oman (Author 2022).....	69
Table 4: Conceptual Framework of Disaster Management in Oman (Author 2022).....	75
Table 5: Benchmarks/Criteria for Assessment of Inter-sectoral Coordination in Oman (Author 2022).....	76
Table 6: Summary of the purpose of How, Who, and What in the CF (Author 2022).....	80
Table 7: Inclusion/Exclusion Criteria (Author 2022)	91
Table 8: Characteristics Distribution of interviewees according to Category (Author 2022)	93
Table 9: Description of NCEM Membership Based on Sectors (NEMP 2018)	114
Table 10: Summary of the Eight Sectors (NEMP 2018)	122
Table 11: Matrix of Network Relationships (Hagbarg et al. 2018)	123
Table 12: Top 10 organisations in the NDMS Ranking (Hagbarg et al. 2018)	128
Table 13: Roles of Sectors in the Response to Disasters (Author 2022)	160
Table 14: Response Network Matrices (Hagbarg et al. 2018).....	163
Table 15: Top five organisations under different centrality measures in the response network (Hagbarg et al. 2018)	168
Table 16: Compromise between EMN and Response Network (Author 2022)	171
Table 17: Roles of Sectors in DRR (NEMP 2018)	183
Table 18: Network Matrices (Hagbarg et al. 2018)	194
Table 19: Top five organisations under different centrality measures in the Risk Reduction Network (Hagbarg et al. 2018)	197
Table 20: Comparison between EMS Network and Risk Reduction Network (Author 2022)	201
Table 21: Comparison between Response Network and Risk Reduction Network (Author 2022)	225
Table 22: Comparison of RR and Response in Oman (Author 2022)	229

Acknowledgements

This research would not have been completed without the contributions and support of many individuals. I am profoundly grateful for the unwavering support and guidance of many who have made this journey possible.

To my father, a dedicated educator, whose lifelong commitment to teaching has deeply inspired my academic endeavours. His devotion to education has illuminated my path. My mother, an embodiment of admiration for knowledge and education, whose selfless sacrifices for her children have laid the foundation of my achievements.

To my wife, my steadfast companion, whose encouragement and support have been pivotal throughout my professional and academic journey. Her exceptional dedication to our family has been the bedrock of my perseverance. To my children, whose understanding and support have been a source of continual motivation and joy. Your faith in me and your unwavering support have been crucial in navigating the challenges of this journey.

I extend a special note of thanks to Professor Lee Miles, my supervisor, whose expert guidance and insightful mentorship have been invaluable in this academic pursuit. His wisdom, patience, and academic rigour have profoundly shaped both this work and my personal development as a scholar.

I also wish to express my profound thanks to the individuals who facilitated and participated in the semi-structured interviews and to Bournemouth University's Disaster Management Centre for their kind support.

Author's Declaration

I declare that this thesis has been composed solely by myself and that it has not been submitted, in whole or in part, in any previous application for a degree. Except where states otherwise by reference or acknowledgement, the work presented is entirely my own.

Chapter 1 Introduction

The Sultanate of Oman's topographical location makes it prone to natural environmental disasters. The country is situated in the middle of coastal territories, close to three large bodies of water; the Arabian Sea, the Persian Gulf, and the Gulf of Oman. Oman has borderlines with the south-eastern end of the Arabian Peninsula near an area of active oceanic plates exposing it to the constant threat of earthquakes, tsunamis, tropical cyclones, floods, and other hydrological hazards such as storms, drought, and coastland erosion. In addition, shifting dunes and sinkholes pose a significant threat to agricultural land, road networks, and other infrastructure. Oman is also susceptible to health and anthropogenic hazards.

The issue of climate change further exacerbates the problem of environmental disasters in Oman. The Intergovernmental Panel on Climate Change (IPCC) (2018) asserts that climate change impacts the rate of occurrence and the intensity of disasters globally. Additionally, the marking of the 7th Sendai Framework for Disaster Risk Reduction (2015-2030) held in Geneva, *in* 2022 elaborates on the severity and harm caused by global climate-related emergencies. Furthermore, the framework suggested actions to deal with emergencies and the impact of catastrophe risk to lessen victims' pain and the level of damage. The Sendai Framework's initiatives proposed measures that address the three aspects of disaster risk; exposure to hazards, vulnerability and capacity, and hazard characteristics, to prevent the emergence of new risks, lessen the impact of current risks, and boost resilience (UNDRR 2022).

Therefore, the probability of a disaster in the Arabian Peninsula, particularly in Oman, is increasingly high. It is essential to have a long-term contingency plan entrenched in Oman and the Oman Disaster Management System in response to potential disasters. Public records released by the World Bank Group showed that Oman had suffered considerably from natural hazard-induced disasters in recent years and is still susceptible to drought, cyclones, sand and dust storms, and flooding in the future (Benson and Clay, 2004).

Incessant occurrences of natural disasters compelled the Omani government to embark on several reforms to minimize the negative impacts. This study looks at how Oman has performed since the introduction of reform measures from 2010 to 2020, and what can be done to improve the system. Moreover, the emergence of the COVID-19 pandemic is another test for the disaster management system. Accordingly, this study uses the end of the year 2020 as the time limit for the study. The IPCC suggests that the development of effective DRR plans can play an

important role in supporting communities to adapt to the adverse effects of climate change. Therefore, increased investments in DRR are a critical step to supporting vulnerable communities. However, it is essential to fully understand the dynamics of a disaster before an optimal level of investments can be realized.

The nature of risks and vulnerabilities may vary across regions and within countries, but the impacts of disasters are similar, and the need to develop a common approach to protect vulnerable communities is paramount. Apart from climate change, Oman has additional challenges of population growth, expanding urban areas, and geographical factors that can be a recipe for disaster. According to Reilinger et al. (2006), Oman lies on a seismically active Makran trench that arises from the convergence between the Eurasian Plate and the Arabian Plate. Furthermore, Oman is situated in a politically unstable region with numerous conflicts between countries and religious groups, exposing it to human-made disasters (Aras and Yorulmazlar 2017; Dynes 1994). The increased likelihood of both natural and anthropogenic disasters and the fact that Oman is politically exposed makes it necessary to undertake this research.

The two unprecedented major cyclones that happened in Oman in 2007 and 2010 had a tremendous impact on the country and questioned its emergency management system. Cyclone Gonu occurred in eastern Oman on June 6, 2007, with devastating winds of 150 km/h (90 mph) and was considered the most powerful tropical cyclone to have happened in the Arabian Peninsula. Similarly, Cyclone Phet happened on June 3, 2010, with landfall winds of 120 km/h (75 mph) northeast of Masirah, in Oman, with a catastrophic impact on the affected communities (India Ministry of Earth Science 2011; NASA 2007). The cyclones mentioned above have increased awareness of how vulnerable Oman is to natural disasters (Al-Shaqsi 2010; Fritz et al. 2010; Hoque et al. 2017).

The effects of such hazards can quickly transform into disasters that occur in dynamic settings and which, on impact, often require quick search, exchange, and absorption of information across diverse agencies involved in response and recovery. Guntzburger and Pauchant (2014) note that a particular event triggers a natural induced-hazard and there are always underlying complex processes of technological, cultural, and legal factors that compound the situation to make it a national disaster. Thus, in Table 1 below discloses all the cyclones that struck Oman since 1977, that necessitated a comprehensive approach to disaster management. Table 1 below shows the cyclones that hit Oman and their effects.

Table 1: Cyclones that Hit Oman and their Effects (NCEM 2021)

cyclone	Month/Year	Characteristics and Effects
Masirah 1977	June 1977	<p>The amount of rain reached (430) mm on Masirah Island</p> <ul style="list-style-type: none"> • Winds of 165 km/h and gusts of 230 km/h • Damage to some public and private properties and some citizens' homes • Wave height on some coasts of Dhofar Governorate reached (6.5) meters <p>The number of deaths recorded 12 deaths</p>
Masirah	June 1996	<ul style="list-style-type: none"> • Rain reached (90) mm on Masirah Island • The death of one person • Floods in remote areas • A Somali ship sank, killing 11 passengers on board <p>Note: Some information indicates that the situation caused floods in the Republic of Yemen, which led to the death of 300 people and 100 missing persons</p>
Salalah	May 2002	<ul style="list-style-type: none"> • The rains caused floods and damaged public and private properties in the Wilayat of Salalah <p>8 people, including members of the response teams, died during rescue operations</p>
Guno 2007		<ul style="list-style-type: none"> • Winds of 180 km/h in Qalhat • Mina Al Fahal (oil exporting port) closed for two days • Significant damage to public and private property and the drifting of many vehicles • Interruption of electricity, water, and road services <p>47 deaths</p> <p>Losses estimated over 4 billion Oman Riyal (around 10 billion \$)</p>
Phet 2010	May 2010	<ul style="list-style-type: none"> • Winds of 120 km/h • Serious damage to power lines, road networks, and private and public properties • Large numbers of vehicles drifting <p>16 people died</p>

cyclone	Month/Year	Characteristics and Effects
Mekuno 2018	May 2018	4 people died. significant impact of basic services such as roads, communications, electricity, and water networks in some areas of Dhofar Governorate
Shaheen 2021	September 2021	<ul style="list-style-type: none"> • Wind gusts of 166 km/h • 12 deaths • Lots of vehicles drifting and water entering residential neighbourhoods. • The death of a large part of the livestock and fisheries • The impact of basic services such as roads, electricity, water and communications in some areas • Closure of Muscat International Airport for several hours

The contemporary approach to disaster management uses coordinated pre-disaster plans in a holistic manner that identifies the threat, risk levels, and strategies for collective response and recovery (Pirasteh and Li 2017). A holistic disaster management approach would consist of four components mitigation, preparedness, response, and recovery (Paton and Johnston 2017). In mitigation, the objectives include prevention, reducing the probability of the event happening, and minimising the effects of the disaster if it happens. Preparedness is concerned with planning and implementing policies and recommendations before the impact. In contrast, response describes all actions taken in the immediate aftermath of the disaster. At the same time, recovery refers to all actions aimed at accounting for lives, property, and a return to normality (Paton and Johnston 2017).

Disaster management involves strategic planning and preparedness to respond effectively to occurring disasters. It requires effective collaboration between agent teams and affected populations (Eller et al. 2015). In the past, effective interactions between the two groups have been seriously affected by limited human situational awareness and rigid interaction policies and strategies of the agent teams (Jensen and Waugh 2014; Owen and Hayes 2014). However, studies of disaster events in recent times have provided a better understanding of the strategic concept of inter-sectoral coordination, its form, nature, and effectiveness within disaster management systems (Eburn & Dovers 2015; Hashemipour et al. 2017).

Lessons learnt in the wake of the two separate disasters caused by Cyclone Gonu and Cyclone Phet respectively prompted the introduction of a new system of disaster management in Oman – one that is based on a cluster structure approach recommended by consultants during the reform process organised by the Government of Oman. Each cluster/sector is given a specific function to perform from a list that includes the provision of early warning, public information management, search and rescue, relief and shelter, critical infrastructure, victim’s affairs, and hazmat response. The current approach to managing national emergencies in Oman was introduced in 2011 and officially endorsed in January 2018. The Inspector General of Police and Customs Decision 28, 2018 endorsed the revised National Emergency Management Plan (NEMP 2018).

The disaster management system that existed in Oman before 2010 represents the conventional approach to disaster management which is made up of the ‘3Cs’ of disaster management: communication, coordination, and control (Al-Shaqsi 2011; Jung and Park 2016; Özdamar and Ertem 2015). However, this system is a conventional approach used to address disasters and emergencies. It often involves established protocols, processes, and organisations that have been around for a while and have proven relatively effective in managing different types of disasters, though not without limitations (Al Saadi 2018). This description of the classic system reflects the Oman Disaster Management System that follows a linear and hierarchical structure, with clearly defined roles and responsibilities for different agencies and personnel involved in disaster response and recovery as contained in the National Committee for Emergency Management (NCEM) reformation act 2008. The shortcomings associated with the classic system were underlined by Comfort and Hesse (2007a) in their submission, using Hurricane Katrina in the USA to prove their point since the USA operates the classic system. She asserts that events, such as the failure of decision-makers to effectively communicate the risk and urgency of the danger to participating agencies during and after Hurricane Katrina in the USA, prove that the traditional approach is no longer viable. Therefore, researchers (Comfort and Hesse 2007a) suggest a new approach to emergency management that recognises the process as a complex and adaptive system (Boersma et al. 2014; Paton and Johnston 2017). The new approach reframes inter-sectoral coordination by acknowledging the role of cognition in altering the interaction among the 3Cs. It also provides a more adaptive and flexible definition of the 3Cs to make them more relevant to the situation (Kaynak and Tuğer 2014). Thus, cognition in this context is defined as “the triggering insight of emerging risk that initiates the emergency response process” (Comfort and Hesse 2007a).

The experiences in Oman in the 2007 and 2010 disasters present an opportunity to examine the effectiveness of disaster management systems in Oman and develop a more effective and applicable approach in line with the UN plan action on disaster control. Thus, the UN action plan demonstrates commitment and preventive measures toward risk disaster management. The plan is classified into three steps; to enhance system-wide coordination in support of the Sendai Framework and other accords, using a risk-informed and integrated approach. Also, to increase the UN system's capacity to provide coordinated, high-quality support to nations on disaster risk reduction. Lastly, to make sure disaster risk reduction remains a strategic priority for countries and among UN agencies (UNISDR 2017). Although the Government of Oman carried out reforms in the post-2010, making considerable progress in emergency management (with the National Committee for Emergency Management spearheading preparedness and response operations), there is still a need for a more sophisticated approach to the development of formal rules and informal measures, as well as the development of an effective strategic partnership with local and international organisations. Oman has adopted a multi-hazard EMS. This study includes an examination of Oman's COVID-19 response, but only as an operational consideration and not as a specific case. COVID-19 is just one variable since the focus of this study is on assessing a multi-hazard system.

This research seeks a better understanding of how to integrate the recommendations in the UN guidance into the existing cluster system in Oman, as well as to provide a more detailed, complexity-informed, conceptual understanding of inter-sectoral co-ordination in non-western societies. As such, the conceptual framework in this study focuses on three elements, namely Governance, Network Characteristics, and Coordination Process. The framework is built on a theoretical background that views this study as interpretive, qualitative research (Creswell 2014). While it utilises some background concepts drawn from Complexity Theory and Coordination Theory, the conceptual framework applies the concept of Social Network Theory to understand the relationships in Oman's disaster management system.

The conceptual framework in this research focuses on three elements, namely governance, network characteristics, and coordination process. Together, the three inter-organisational network dimensions mentioned above provide a comprehensive approach that can be used to explain why inter-sectoral coordination is necessary, how it should be conducted, who is to be studied, and what coordination mechanisms are required.

The integration of the three dimensions (governance, network characteristics, and coordination process) formed a practical, holistic background that can serve as a conceptual framework to

analyse disaster management. At the same time, applicable to the Omani National Disaster Management System (NDMS) and considers the NDMS as a complex adaptive system and that it is malleable by using the insights obtained from the Social Network Theory emerges. The conceptual framework applies Social Network Theory to understand the relationships in Oman's disaster management system. This model can examine the efficiency and effectiveness of existing complex inter-sectoral coordination and coordination mechanisms within each cluster and among all clusters in the Omani disaster risk reduction and response system.

The purpose of this research is to examine the form, nature, and effectiveness of the post-2010 Omani disaster management system using a combination of semi-structured interviews, document analysis, and case studies. This methodology enables the researcher to tap into the literature and the experience and expertise of top government and private sector officials involved in strategic planning and implementation. Therefore, the results are expected to provide new knowledge that will be useful in developing a more robust inter-sectoral coordination framework, a framework that brings together public and private actors in the context of the Oman disaster management system. In addition, research findings will inform disaster managers in regional and international emergency management on the efficacy of the cluster system introduced in Oman.

1.1 Aim

This research aims to develop a more sophisticated strategic concept of inter-sectoral coordination, with a focus on DRR and response, and investigate its form, nature, and effectiveness within the post-2010 Omani emergency management sector-based system while examining issues such as resource sharing and management, leadership and managing operations will be addressed.

1.2 Objectives

The objectives are as follows:

1. To explore the possibilities of establishing an effective, inter-sectoral co-ordination framework as an approach to disaster risk reduction and response in a disaster management system.
2. To examine the reliability and effectiveness of existing complex inter-sectoral coordination and coordination mechanisms within each cluster and among all clusters recognised in the post-2010 Omani disaster risk reduction system,

3. To provide recommendations for inclusion in strategic and operational guidelines for both formal and informal inter-sectoral coordination in a reformed post-2010 Omani disaster management system, as informed by theoretical and empirical findings.

1.3 Research Questions

This research seeks to answer the following questions:

1. How can a conceptual framework focusing on inter-sectoral coordination be used to provide valuable insights that can reform and enhance the post-2010 Omani disaster management system and professional practice in Oman?
2. How can Social Network Theory be applied to further understanding of evolving and developing effective inter-sectoral co-ordination in a complex disaster management system such as that in Oman?
3. How can inter-sectoral coordination be enhanced/improved in the current Oman Disaster Management System?

1.4 Contribution

One of the main contributions of this thesis was to advance knowledge *by* developing a more advanced concept of inter-sectoral coordination with a specific focus on Oman as a case study. Hence, the issue of how we understand and conceptualise inter-sectoral co-ordination was a key integrative feature across emerging disaster management agendas influencing Oman today. Therefore, addressing emerging knowledge gaps in the field of inter-sectoral coordination, this study explores the possibilities of establishing a ‘complex clustered/inter-sectoral co-ordination framework’ that seeks to:

1. Analyse Inter-sectoral coordination to improve Oman's crisis management procedures overall by enabling cooperation, developing a coordinated response, and utilizing the aggregate experience of many sectors.
2. Evaluate Inter-sectoral coordination to significantly contribute to the effective practice of disaster management in Oman by understanding inter-agencies coordination for a more comprehensive and holistic risk assessment.
3. Enhance academic and professional work on inter-sectoral cooperation/co-ordination and clusters/sectors.
4. Further, contributes to work on social network theory and inter-sectoral cooperation to explore further the critical nexus where recognition of complexity and adaptation

in disaster management meets the need for more effective inter-sectoral structures that can enhance stability in disaster management.

5. Detect synergies and differences in the organisation of complex inter-sectoral cooperation in handling Response and Disaster Risk Reduction issues and phases in Oman.

Table 2: A summary of the research's aims, objectives, methodologies, and questions (Author 2022)

Research Overview		
Aim: Develop a concept of inter-sectoral coordination and investigate its form, nature, and effectiveness within the post -2010 Omani DMS in both Risk reduction and response.		
Methodology: Interpretive Qualitative Inductive approach		
Research Objectives	Methods	Research Questions
1. To explore the possibilities of establishing an effective, inter-sectoral co-ordination framework as an approach to disaster risk reduction and response in a disaster management system.	Literature Review	1. How can a conceptual framework focusing on inter-sectoral coordination be used to provide valuable insights that can reform and enhance the post-2010 Omani disaster management system and professional practice in Oman?
2. To examine the reliability and effectiveness of existing complex inter-sectoral coordination and coordination mechanisms within each cluster and among all clusters recognised in the post-2010 Omani disaster risk reduction system,	Literature Review	2. How can Social Network Theory be applied to further understanding of evolving and developing effective inter-sectoral co-ordination in a complex disaster management system such as that in Oman?
3. To provide recommendations for inclusion in strategic and operational guidelines for both formal and informal inter-sectoral coordination in a reformed post-2010 Omani disaster management system, as informed by theoretical and empirical findings	Document Analysis, SS interviews, SNA	3. How can inter-sectoral coordination be enhanced/improved in the current Oman Disaster Management System?

1.5 Structure of Thesis

The thesis is organised into nine chapters, including this introductory chapter, which gives a general view of the subject under research and the procedures to accomplish the Oman Disaster Management System tasks.

Chapter 2 is the literature review, presenting an analytical assessment of the literature on Omani's disaster management system, focusing mainly on Social Networks as a more comprehensive theory and the Inter-Sectoral Coordination concept as the main analytical framework in the thesis. Thus, the literary works of many scholars, including documents about the research study, were examined to offer diverse views about the approach to emergency management in a complex environment. In addition, other theoretical concepts like complexity and coordination theories were also reviewed to present unbiased arguments regarding the practical application of inter-sectoral coordination in Oman's disaster management system.

Chapter 3 of this research thesis discusses the conceptual framework adopted to explore the approach to Oman disaster management. The network conceptual framework of three dimensions provides an overall view and approach to this research thesis, which was used to develop and organise ideas across sectors. The theory of network governance, network structure/characteristics, and network coordination and collaboration function were extensively explained in practical terms to demonstrate their efficiency in response to an emergency involving a multi-sector and multidisciplinary environment.

Chapter 4 is the methodology, which explores and emphasises the significance of using the appropriate method in a research study. Thus, the reason and purpose for the methodological approach to this research case study on Omani disaster management were plainly explained. Also, this chapter demonstrates the use of interpretative and descriptive methods in researching social problems, as in this case study under focus. It helps answer salient questions, such as 'Why,' 'Who,' 'What,' 'Where,' and 'How,' or 'When' arising in a research study.

Chapter 5 provides an overview of the Omani emergency management system and explicitly discloses the findings from the analysed documents and interviews conducted with the participants about Oman's response to an emergency. In addition, this chapter provides the views of officials working in various sectors of the National Disaster Management System about the government's approaches to natural and human-induced hazards, how effective is the current plan, its sustainability, and improvement. Furthermore, the findings examined in this

chapter reveal the inside activities of the different government agencies involved in disaster management, their roles, and responsibilities.

Chapters 6, 7, and 8 discuss the results from the findings, which cover the issues identified in this research, particularly the ones connected to the main discussion, improving the Oman disaster management system.

Chapter 6 discourse is all about findings on the risk reduction network, mainly examined from the three dimensions' perspectives: risk reduction network governance and network structure. Therefore, the chapter is divided into three main subchapters to provide an extensive explanation of the three dominant issues in the findings. The first subchapter analyses the risk reduction network governance, including discussing the issues related to risk reduction network legitimacy, accountability, and leadership. The second subchapter analyses the risk reduction network collaborative functions, including the risk reduction network coordination system and RRN coordination mechanisms. The third subchapter analyses the risk reduction network structure, including network density and centralisation, and compares the risk reduction network structure and the emergency management network structure.

Chapter 7 discussion focuses on findings related to response networks as strategic designs to solve complex management problems during an emergency. Thus, the chapter discourse is on various complex issues discovered in the findings, centred on interactions among multiple stakeholders, and examines both short- analyses of the semi-structured response network. The chapter is divided into three main subchapters. The first subchapter analyses the response network governance, including discussing the issues related to response network legitimacy, accountability, and leadership. The second subchapter analyses the response network collaborative functions, including the response network coordination system, RN coordination mechanisms, and RN collaborative functions, i.e., planning and standardisation, information sharing, and resource sharing. The third subchapter analyses the response network structure, including network density and centralisation, and compares the response network structure and the emergency management network structure according to the National Emergency Management Plan.

Chapter 8 compares and contracts the response network to the risk reduction network. The comparison is based on the findings and results from documents reviewed and interviews conducted on the Oman disaster management system. The discussion concentrates mostly on the finding that indicates the Government of Oman's efforts to preserve, protect, and fulfil its

obligation to safeguard the state's property and the environment. At the same time, it guarantees all citizens' right to live in the face of threats posed by natural and human-made hazards to the country.

Finally, Chapter 9 is the concluding chapter of this research thesis; it summarises all that has been done in this thesis by pointing out the key findings of the research and relating them to the research objectives and questions mentioned at the beginning of the introduction. This conclusion highlights this thesis's value and contribution to knowledge, including attracting further research on the topic while outlining recommendations and suggestions for stakeholders involved in emergency management systems.

Chapter 2 Literature Review

2.1 Inter-Sectoral Coordination in Omani's Disaster Management System

This thesis theoretical review holistically examines the effectiveness and practical application of inter-sectoral coordination in Oman's disaster management system by intrinsically exploring every connecting part concerning the whole system. Moreover, this chapter analyses the views expressed by scholars regarding the significance of inter-sectoral coordination as a component of Social Network theory and a pragmatic approach to complex intra-organisation networks. Therefore, determining the effectiveness of the Social Network theory in disaster management has attracted academic scholars, researchers, and experts, such as Émile Durkheim (1893-1964), Ferdinand Tönnie (1855-1936), and Jacob Moreno (1892-1974), the forerunners in developing the first sociograms to study interpersonal relationships (Freeman 2004).

Also, other theorists like Wasserman and Faust (1994), Borgatti and Mehra (2009), Easley and Kleinberg (2010), and Scott (2000) mostly focus on providing explanations and understanding of the working and development of inter-sectoral coordination in management, particularly during disasters. Besides, the previous use of social networks to resolve management crises made the theory relevant to this research topic. This literature review chapter is divided into five sections for clarity and easy understanding of the subject. The intent is to analyse and balance the arguments of researchers and scholars objectively, emphasizing Social Network Theory.

However, the first literary analysis in this thesis provides an in-depth view concerning the development of effective inter-organisational strategic disaster management schemes. The second theoretical review delves into the complexity of disasters exploring models like complex adaptive systems and their characteristics, to establish the connection and contrast between existing theories relating to inter-organisational network structure. The third hypothetical analysis explores the meaning and understanding of Social Network Theory, the main theoretical background of this thesis, and its effectiveness in disaster management in a complex environment. Also, to look at the concept of coordination, its main integral features, as well as conditions and mechanisms for operation. The fourth line of scholarly review is to examine explanations offered by theorists on inter-sectoral coordination as an approach to determine the organisation of complex multisector and multidisciplinary agencies in the case of Oman and give an insight into EMS structure. Lastly, an analytical review of complex

adaptive systems and complexity models, to establish the connection and contrast between existing theories relating to inter-organisational network structure.

2.2 Development of Effective Inter-Organisational Disaster Management Systems

This section reviewed the development of effective inter-organisational strategic disaster management schemes based on the concept of complex disaster management as an approach to the disaster management process in Oman. However, there are vital concepts explaining disaster management systems from different perspectives, which are applicable to Oman's case scenario. Besides, the various approaches to emergency management have been classified into; risk reduction/mitigation stage, preparedness stage, response stage, and recovery stage offered by experts. Moreover, the theoretical analysis will give an insight into the complexity of disasters as they connect to hazards, which are sometimes approached through complex adaptive systems.

Thus, to develop an effective and convenient framework for disaster management, it is proper to explain what is commonly considered a disaster for clarity and understanding of the issue. Since disasters are seen as multifaceted phenomena that have become integral to humanity's history. Therefore, any event recognised as a disaster must have a considerable impact on the environment and the people where it occurred, in terms of the scale of damage and destruction, to the extent the affected community cannot handle it alone with their insufficient resources except with external support, which could be internal or external aids (UNDRR 2022).

However, there are similarities in many scholars' definitions of disaster, but are viewed from a different spectrum, which is natural and human-made; either impacts humans negatively. For example, in their submission, Dynes and Quarantelli (1977) describe disasters from the perspective of natural and artificial happenings, such as earthquakes, floods, hurricanes, volcanic eruptions, tornadoes, and tsunamis as well as toxic chemical spills, radiation fallouts, large-scale explosions and fires, structural failures, massive transportation wrecks, crashes and more (Dynes and Quarantelli 1977). Therefore, the large-scale impact on the environment and human social activities is beyond the affected community to handle due to the overwhelming effects of the disasters (Al-Barwani 2016).

Besides, the description of disaster in various governments' official gazettes agreed to an acceptable definition that contains the main characteristics inherent in disaster to enable the development of an effective theoretical research approach like the Social Network. For example, in the U.K, the Civil Contingencies Act 2004 defined a disaster as an "emergency"

or a “major incident” that happens at a higher magnitude, with the capacity to disrupt social activities and cause damage to the environment. For instance, natural disasters that are outside human control, as well as human-made incidents like terrorist attacks may deplete available resources at the government disposal to respond or confront such problems and become threats to human lives and infrastructures. On a similar note, the US agency on disaster management, the Federal Emergency Management Administration (FEMA), sees disaster as a manifestation of a natural calamity resulting from the disturbance of the earth’s crust or human-induced activities leading to severe destruction to lives and properties (FEMA 1996, p.GLO-2).

On the part of the United Nations (UN), the agency under its supervision, the International Strategy for Disaster Reduction (UNDRR), describes a disaster as a catastrophe, massive enough to disrupt the social systems in a community from functioning and turn the community into a desolate environment devoid of human activities like economic and social life due to the losses suffered from the disasters (UNDRR 2022). This specific UNDRR definition of disaster aligned with the theoretical presentation on this topic, adopted in the Oman National Disaster Management Plan (NEMP 2018). Besides, the Bali agenda after the UNDRR Summit in Indonesia emphasized the need to review how risk is governed, how policy is created, and the kinds of institutional arrangements that need to be put in place at the global, regional, and national levels in light of the epidemic (UNDRR 2022)., Aside from official documents providing definitions and meanings to disaster, other stakeholders offered helpful information to explain the term disaster.

On the other hand, another common term connected to disaster management is disaster risk reduction. Many scholars described the purpose of disaster risk reduction in inter-sectoral coordination to avert future disasters and limit the impact of current ones, thereby managing the remaining risks. This approach helps to strengthen the disaster risk management process and sustain meaningful development in vulnerable and affected communities (UNDRR 2022, p.11). Consequently, the policy model of preventing foreseeable disasters and reducing the risk associated with such disasters is known as disaster risk reduction (DRR). Sometimes, DRR is used to depict disaster risk management (DRM), and both are interchangeably applied in the planning and implementation of hazard management. The bottom line is that both explain the process of reducing risk (UNDRR 2022).

Evidence showed that DRR activity is broken into segments, and each segment is to accomplish a specific task since DRR is designed to fast-track the community’s recovery process in

catastrophes. Therefore, prevention, mitigation, transfer, and preparedness are integrated systems in the disaster risk reduction approach to management.

2.3 Operationalization of Disaster Risk Reduction (DRR)

However, for an effective theoretical approach to emergency management, the designed DRR plan determines the outcome of the operation. Thus, some scholars argue that disaster risk reduction is useful in disaster management since it helps prevent the enormous risk from catastrophes and reduce the risk from current disasters. Moreover, it provides a solid foundation for the economy to recover, including social lifestyles, health, and replenishing the environment (Crowston et al. 2015; Munang 2013). Therefore, to achieve sustainable development in society, disaster risk reduction is required to encourage the policy objective of disaster risk management to boost resilience. Thus, disaster risk reduction not only saves lives, but also contributes to their improvement, allowing groups like Concern Worldwide organisation to allocate more finances to long-term development rather than immediate disaster response (Solecki et al. 2011). These are the policy objectives of the global disaster risk reduction framework enshrined in the United Nations policy declaration adopted from the Sendai Framework for Disaster Risk Reduction 2015-2030. The policy timeframe is expected to last for a decade and a half to allow agencies to develop and achieve a considerable feat in disaster risk reduction to minimise significant loss of lives, sources of livelihood, properties, economic, and social activities, and environmental disruption of affected communities (UNDRR 2022).

Besides, the development of the Sendai Framework 2015-2030 is followed up to the Hyogo Framework as an agreement among member states of the United Nations Organisation aimed at motivating the development of an effective approach to achieving a substantial reduction of disaster risk and losses in lives, properties, and assets across the globe. The Sendai agreement identifies the State as having the primary role in disaster risk reduction but proposes a system of shared cooperation and responsibility among all stakeholders (UNDRR 2020). Figure 1 below illustrates disaster management stages.

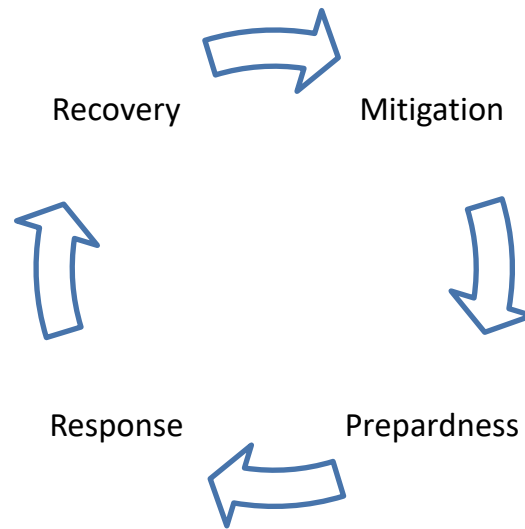


Figure 1: Shows Disaster Management Cycle (Coppola 2011)

It is imperative to state that each stage of DM demonstrates policies initiated by the government and non-governmental agencies to reduce the effect of disasters based on these processes risk reduction/mitigation stage, preparedness stage, response stage, and recovery stage (Coppola 2011).

However, there are contradicting views concerning the disaster management cycle due to its shortcomings. It is considered as a common graphic illustrating how disasters are managed without providing a substantial solution to disaster risk reduction. For instance, Boshier and Chmutina (2021) see the disaster risk management concept as cyclical elements, made up of several operational phases that only conceptualize and depict disasters in an overly simplified way that often begins with a catastrophic "event" and then moves onto yet another disaster. The difficulties in comprehending disasters and their hazards have shown that such circular thinking is not very helpful. On the contrary, some scholars criticized the Sendai Framework for Disaster Risk Reduction (SFDRR) plan. They argue that it was too technocratic and relied too heavily on two ideologies: the modernization theory of development and the notion that science and technology should be given the task of resolving human-made issues like disaster risk vulnerability (Piñeros 2020).

2.3.1 Stage 1: Risk Reduction/Mitigation

Research studies referred to mitigation as a strategic policy designed to reduce the negative impact of disasters on the victims and the environment due to the scale of destruction and damage (UNDRR 2022). Moreover, mitigation helps lessen the devastation of calamities or

prevent anticipated ones from happening (Coppola 2011). The utilisation of the mitigation approach depends on the appropriate time to use it, and it could be before the disaster, during, or after the tragedy has occurred. However, according to Al-Barwani (2016), it is frequently applied as a precautionary measure to forestall possible disasters. Indisputably, it is agreed by experts and pundits that the adverse effects of disasters cannot be excluded, rather, the large-scale impacts can be strategically reduced through mitigation measures (UNDRR 2022).

It is established that mitigation measures require adequate planning and time from government institutions and civil organisations, including special funding and cooperation among various stakeholders involved in disaster management to execute governmental and non-governmental policies and projects directed toward reducing or preventing the destructive impacts caused by hazards in affected communities and likely vulnerable ones (Al-Maawali 2018; Dooley et al. 2003). Similarly, the terms “risk reduction” and “mitigation” are used interchangeably, and for the sake of consistency, this research will use the term “risk reduction” to refer to “mitigation”.

2.3.2 Stage 2: Preparedness

Preparedness is an essential inherent part of disaster risk management, and it is considered the measure used to determine the level of commitment of government and non-governmental sectors to disaster management. Preparedness shows the designed plans, capability, resources at disposal, and readiness of government agencies and civil organisations to respond to emergencies and initiate a recovery process. Still, put in place modalities to prevent anticipated disasters from happening (UNDRR 2022, p. 21). Therefore, the preparedness stage helps support the mitigation measures, not replace them, by developing the capacity required to effectively manage and control different kinds of disasters to accomplish set objectives from the response, recovery, and possible prevention (Dynes and Quarantelli 1977).

From Cannon-Bowers and Salas (2001) viewpoint, preparedness entails actions needed to organise responders and ordinary people in the post-disaster process. The preparedness measures for disaster management include planning, enhancing response capabilities and resources, preparing evacuation shelters, stockpiling equipment and supplies, developing coordination arrangements, continuous training exercising, and plan testing.

2.3.3 Stage 3: Response

Response procedure in DRM activities is acknowledged by scholars, for example, Damon P. Coppola (2011) describes response measures in disaster risk management as the process of

limiting or preventing the side effects of catastrophes that have happened or happening, as well as the foreseeable ones from occurring, to avoid loss of lives, destruction of properties, and damage to the environment (Coppola 2011). According to the UNDRR (2022) declaration act, the primary function of response measures is to protect lives, ensure public safety, and offer essential needs to affected victims of disasters. In practice, organisations' swift response to disasters is determined by the high level of preparedness measures to handle emergency crises. Therefore, response measures are activated based on available resources, and the response network system is in place to mobilise the affected community to reduce human casualties and huge property loss. However, the main functions of response measures are to sound out a public warning, evacuation and sheltering, medical care, search and rescue, environment protection, and more (Al-Shaqsi 2010). It is observed that communication is the primary feature in response measures during disasters due to the complexity of its nature.

2.3.4 Stage 4: Recovery

The recovery stage is an important measure in the whole of DM activities because it makes the process a complete success or failure. However, more often, many social-economic, governance, and environmental issues emerge in the aftermath of disasters that need to be resolved for the victims to return to normal standard life. The recovery measures help restore the affected community through economic activities, social and cultural activities, cleaning up of the environment, and health, all in line with the sustainable development goals of the UN. At the same time, a strategic measure like the 'build back better' initiative is activated to prevent future reoccurrences (UNDRR 2022). Moreover, recovery measures in DRM are usually classified into short and long-term measures to achieve the desired result after disasters. The recovery process starts after response operations have finished their tasks.

Nevertheless, all stages and efforts in the disaster management cycle are directed toward ensuring victims of natural or artificial disasters are well attended to and taken care of by the appropriate government and non-government agencies. The different stages in DM are linked to achieving a collective objective of reintegrating victims of disasters into society to live normally, even better than their former standard of living before the tragedy happened (Coppola 2011). Besides, scholars argue that the recovery process is not only about resettling the affected population but also assisting in rebuilding the community, restoring the infrastructures destroyed, and ensuring the destroyed social sector is revived to alleviate the suffering of the victims of hazards. The recovery measures will allow the children to return to

school and the parents to return to their livelihood sources (Al-Shaqsi 2015). Like response networks, the recovery stage requires a collaborative cross-sector network that is made up of government and non-government agencies (Apte et al. 2016).

The four-stage approaches in disaster risk management discussed above helped divulge the significance and relevance of the disaster risk management approach in inter-sectoral organisational structure. Based on this research analysis, scholars proved that each of the four stages in DRM activities is identified by their different goals, objectives, types and nature of activities. The main focus of this research is on the mitigation/risk reduction and the response stages. To assess the effectiveness of collaborative efforts and coordination mechanisms, both the mitigation network (referred to as risk reduction in this research) and the response network will be used to analyse the case study of Oman's disaster control and management.

2.4 Complexity of Disasters

Research studies have shown that disasters could arise from natural and human-induced hazards. Both types of hazards result from the combination of vulnerability and inadequate measures to lessen the anticipated risk associated with the complex nature of disasters. For instance, Smith (2019) advocates the paradigm shifts in the complexity of disasters and susceptibility to tragedy brought on by the intricate relationships between nature and society due to environmental degradation and the impact of human-caused climate change, as a result, these dangers have increased in frequency and severity. This has the crucial implication that vulnerability may not only be interpreted as a measure of how susceptible individuals are to risks but also as a gauge of how well the environment surrounding society is doing. Afterwards, scholars attribute the features connecting various disasters to the socio-economic vulnerabilities that need the involvement of cross-sector organisations and agencies (Scheidegger 1997).

The unpredictability nature of emergency patterns hinders stakeholders from accurately determining the kind of support needed to approach a complex disaster. Therefore, risk evaluation estimates the potential damage a calamity can cause if preventive measures do not stop it (Clark-Ginsberg and Blake 2020). Moreover, hazard identification includes the examination of the technical aspects of disasters, such as their location, concentration, rate, and probability, as well as a look at the exposure and susceptibility, taking into account the social-economic, political, physical, and environmental aspects to conclude the extent of damage (Basak et al. 2011).

Complex Inter-organisational disaster management systems are expected to develop toward collective efforts and resources to achieve disaster management strategic policy goals. Collaborative systems are vital in solving the complex nature of disasters through cooperative organisational structure, information sharing and decision making, resource management, and activities and tasks integration.

2.5 Framework of Complexity of Disasters

It is ascertained that the approach to a complex disaster is better explained through complexity theory, which aims to provide an understanding of how characteristics, behaviour, and relationships at the micro-level of a complex system lead to macro-level outcomes (De Roo and Hillier 2016; Eisenhardt 2017). It is concerned with how order emerges from an apparently disorderly system (De Roo and Hillier 2016; Eisenhardt 2017; McKenzie and James 2004; Sherif 2006). Complexity in this context is defined as “a measure of the state of diversity in the nature of the elements that make up a system, as well as the relationship between these elements and the external environment” (Lepore et al. 2016).

The new organisational environment has resulted in increasing complexity arising from growing numbers of agents and stakeholders, as well as changing physical and socio-political landscapes. Complexity Theory on the other hand appears to be a better approach for capturing the complexity and uncertainty surrounding change management processes in the contemporary environment (Amagoh 2008; Friday et al. 2018; Price 2004).

Besides, one of the key concepts in Complexity Theory is known as entropy, a well-known concept in physical and biological sciences (Normandin and Therrien 2016). Entropy is a measure of disorder in a system and denotes the propensity to transform into a random state in which there is no prospect for the system to work (Normandin and Therrien 2016). Byeon (2005) describes entropy as disorganisation or lack of patterning in an organisation.

2.5.1. Complex Adaptive Systems

An important derivative of Complexity Theory is the idea of complex adaptive systems, applicable in the theory and practice of disaster management (Foster et al. 2015). Axelrod and Cohen (1999) define complex adaptive systems as, “a world where many players are adapting to each other and where the emerging future is extremely hard to predict” (p. xi). A network in a disaster management system is defined as the totality of individuals, organisations, and communities operating in collaboration, both in the public and private space, with the aim of

pursuing shared goals and addressing common problems such as mitigating the effects of emergencies and disasters (Comfort and Hesse 2007; Vvon et al. 2008).

Comfort (2007b) suggests a new approach to emergency management that recognises it as a complex and adaptive system, a perspective that has gained recognition among researchers and practitioners (Boersma et al. 2014; Paton and Johnston 2017; Sikula et al. 2015). The new approach reframes inter-sectoral coordination by recognising the role of cognition in altering the interaction among the 3Cs, namely communication, coordination, and control (Howes et al., 2015; Kaynak and Tuğer 2014). Cognition in this respect is defined as “the triggering insight of emerging risk that initiates the emergency response process” (Comfort, 2007b, p.189). In this way, complexity seeks to highlight the need to link Disaster Risk Reduction (DRR) with response processes – although there is clearly a need for much greater work to be undertaken in this regard in terms of understanding inter-sectoral coordination (Coetzee et al. 2016). Nevertheless, according to Comfort (2007b), cognition transforms the 3Cs from static or disconnected elements to adaptive and coordinated components.

The new approach, the complex adaptive systems approach, infuses risk management, relief, and response into models that place emphasis on the physical, social, and economic vulnerability of communities and investments in the long-term mitigation of disaster events (Dwyer et al. 2004; Hashemipour et al. 2017; Kapucu 2008). The models have their foundations in Complexity Theory and focus on the structure and architecture of complex adaptive systems. Thus, they go beyond response to disasters to engage in more proactive approaches that include prevention, preparedness, and mitigation strategies (Weichselgartner 2001; Basak et al. 2011). The architecture of the symbiotic relationships found in complex disaster management adaptive systems, including the structure of interactions of sectors, organisations, governments, and individuals, has been observed to be similar to that found in biological or ecological systems (Ramos-Villagrana et al. 2018). In particular, learning and adaptation processes take the same form (Holland 1995; Epstein and Axtell 1996). Complex adaptive systems can learn by absorbing information from the environment to create knowledge that is useful for adaptation (Fioretti and Visser 2004; Mason 2007; Fath et al. 2015).

Complexity Theory holds that complex adaptive systems move towards maintaining coherence and persistence (Holland 1995; Northam 2014). Thus, emergencies and disasters compel organisations to move toward greater levels of complexity through the creation of inter-organisational networks, which invariably become adaptive systems as the networks experience increased transactions and changing environments (Northam 2014; Ramos-

Villagrasa et al., 2018). In the emergent network structure, no single individual, department, or organisation is likely to have sufficient insight or capacity to affect directly the outcome of the network because, according to Complexity Theory, a non-linear cause-effect model is assumed to be in place (Kilduff and Tsai 2007). However, each part of the adaptive system, similar to biological systems, operates in its own interest but the confounding effect is to collectively give direction to the system as a whole (Gimenez et al. 2017; Heinemann and Hatfield 2017; Ramos-Villagrasa et al. 2018).

By operating in its best interest, each part of the adaptive system introduces entropy into the system. However, the ability of the adaptive system to learn and restructure, thereby reducing entropy is what sets complex adaptive systems apart from other systems. In other words, in complex adaptive systems, order is maintained through explorations and innovations. From this perspective, a distinctive feature of complex adaptive systems is the emergence of an improved system through self-organisation (Coetzee et al. 2016; Howes et al. 2015; Mason 2007). This is particularly important in developing or emerging disaster management systems like Oman where the system itself is developing and not all rules may be perfect or in place, and where self-organisation is also part of filling in the gaps as it develops. According to Comfort (2007a), self-organisation is a continuous process of communicative acts necessary to rearrange and reform disaster management systems. Self-organisation in a sociotechnical system such as disaster management combines flexibility with sufficient structure to adapt to rapidly changing environments.

In applying Complexity Theory, organisations give priority to engaging in learning processes that provide increased potential for adaptation to external environmental conditions. These learning processes lead to changes not only in strategies and internal structures but also in the behaviour of agents in the system (Paraskevas 2006). Thus, Complexity Theory provides a better understanding of how to use significant latent features of complex adaptive systems, namely self-organisation, emergence, adaptation, and cooperation to improve the performance of networks of organisations inherent in all cycles of disaster management (Norris et al. 2008; Fath et al. 2015; Mendes et al. 2016; Blackman et al. 2017). By approaching disaster management systems - such as preparedness, response, and community resilience - as complex adaptive systems, it becomes easier to visualise how individual capabilities of actors within the system interact to produce positive emergent outcomes (Norris et al. 2008; Fath et al. 2015; Mendes et al. 2016; Blackman et al. 2017).

In addition to self-organisation, there are three other basic features of complex adaptive systems that are directly applicable in disaster management studies: interdependence, diversity, and modes of interaction (Mason 2007; Howes et al. 2015; Coetzee et al. 2016). Complex adaptive systems are made of large numbers of interdependent and heterogeneous agents that interact with each other as well as with the external environment. Each agent has the capacity to use information and knowledge gained from experience to change their behaviour to become more adapted to the surrounding environment (Hazy and Uhl-Bien 2014). In a social system such as a disaster management system interdependence implies that decisions and actions by agents may affect other actors in the system (Mitleton-Kelly 2003; Hazy and Uhl-Bien 2014).

Complexity Theory offers a platform for unravelling the factors and conditions that shape the relationships between the agents and which in turn shape interdependence between them (Antonacopoulou and Méric 2005; Fath et al. 2015; Foster et al. 2015). Diversity is also an important feature that may increase complexity. Diversity means that each actor is different from all the other actors but depends on the others and the system as a whole for respective performance. According to Holland (1995), the functions of each actor are invariably defined, and its behaviour is influenced, by its relationship with the others.

The fourth feature of complexity, namely modes of interaction, can be described as shared models. Modes of interaction are "a set of rules that reflects regularities in experience and enables a system to determine the nature of further experience and make sense of it" (Stacey 1996 p.289). Examples of modes of interaction in social organisations are strategic policy and product design (Al-Shaqsi 2011; Stacey 1996). Mitleton-Kelly (2003) notes that actors in a complex adaptive system constantly scan the environment with the aim of developing new strategies for survival. Comfort (2007b) states that Complexity Theory applied in the study of the dynamics of complex adaptive systems is relevant and useful in obtaining a better understanding of the problems and risks involved in inter-organisational coordination and collaboration.

In applying Complexity Theory to complex adaptive systems, such as the inter-organisational network for disaster management, the underlying assumption is that a system composed of multiple agents can adapt more effectively to challenges than individual actors offering uncoordinated efforts to address the same challenges (Comfort, 2007b; Coetzee et al. 2016).

Now, since in a complex adaptive system, patterns of interactions are continuously changing, the development of a management structure that is flexible and able to hold and exchange

relevant information necessary to make effective decisions becomes a top priority for the network (Kauffman 1993; Callaghan 2016). However, the number of actors in a network determines the number of possible permutations of relationships in an effective logical system structure. The number grows exponentially as the network membership increases. It increases even further as events unfold because emergency and disaster conditions result in increased interactions among actors. This means that complexity increases further (Norris et al. 2008; Fath et al. 2015; Mendes et al. 2016; Blackman et al. 2017). It also means that it raises challenges for command-and-control ideas of systems since there is a need for flexibility to accommodate the increasing complexity. Flexibility has long been seen to be very important in responding to disasters. For instance, Dynes (1994) suggested a flexible approach to emergency management systems to replace well-established but more rigid command and control systems used in large-scale disasters (Dynes 1994).

To build an effective coordinated disaster management system that minimises the increases in complexity as the dynamics of disaster unfold, it is important to closely examine the initial conditions of the environment; initial conditions, in this case, being the status of the defining characteristics of the community in terms of risk, preparedness, and resilience. Complexity Theory is sensitive to initial conditions. It is also path-dependent and allows for continuous change in perceptions of concepts and events (Ramalingam et al. 2008). In a complex adaptive system, actors' arrangements and interdependent relationships are fluid, unpredictable, and subject to change at any time (Norris et al. 2008; Fath et al. 2015; Mendes et al. 2016; Blackman et al. 2017). Complexity Theory posits that the initial conditions determine the structure of the coordinated response to the disaster and by focusing on holism and interdependency, network managers can use Complexity Theory to provide insights into how inter-organisational relationships can be built in all phases of disaster management (Kapucu 2009; Fath et al. 2015; Mendes et al. 2016; Blackman et al. 2017).

2.6 Social Network Theory

The Social network theory is the main research theory used in this thesis, as the complexity concept analysed in the previous section is considered a circumstantial aspect of SNT. Social network theory is considered one of the proven approaches to disaster management, given the contribution of several scholars. For instance, Moynihan (2008) understands social networks from the perspective of inter-organisational network activities inherent in the social network theory, designed for organisational systems to pursue a common goal and achieve the same objective (Moynihan 2008). However, in exploring Social Network Theory as a theoretical

framework to determine network effectiveness in inter-sectoral coordination of disaster management systems, emphasis will be on specific aspects of the theory. Moreover, since SNT is extensive with several concepts and given the nature of the research, the focus will be on network governance and network coordination to comprehensively explore the significance and applicability of the Social Network Theory approach to emergency management.

In support of the use of the SNT approach to disaster management, Agranoff and McGuire (2003) and Bryson and Crosby (2008) stressed that the social network theoretical approach to management is an integral part of modern organisational networks, which enables them to access more information and resources to solve complicated issues through collaboration. On their part, Ormston et al. (2014) and Boshier and Chmutina (2021) posited that the inter-organisational structure is the premise on the social network approach as emerging networks comprised of multi-organisational outlets either commissioned to operate by constituted authority or are independent with the same purpose of responding and finding a solution to complex problems confronting humans and their environment and require collective efforts and joint resources to handle them.

In practice, inter-organisational networks provide a flexible arrangement that allows organisations to operate effectively across organisational boundaries and jurisdictions without unnecessary hindrances. In their literary work, Milward and Provan (1998) posited that network structure enhances information sharing, and knowledge building, nurtures innovation, and improves service provisions. Furthermore, Kapucu (2009) emphasised that adequate preparation gives organisations an edge to respond to emergent situations swiftly. Still, Paraskevas (2006) and Boyer-Villemare et al. (2014) considered inter-organisational networks a collaborative approach to effective disaster management.

On the other hand, Kapucu (2006) described disaster management networks as inherent in in-service provision. Within Service provider networks, there is disaster management inscribed in inter-organisational networks. They are usually formal networks established by appropriate institutions and have legal backing to function and perform some specific roles, as well as operate under certain rules, with a defined structure to coordinate stakeholders, enhance actors' commitment, and contribute to networks' functional stability and effectiveness (Comfort and Hesse 1999; Rizzo 2018). However, most disaster management networks are established by governments to perform specific responsibilities on behalf of governments. Therefore, they function within defined frameworks, and their operation plans are according to task description with a predefined proposal for joint planning and decision making, coordination mechanisms,

information and resource sharing procedures, and joint action command system (Kapucu 2008). Inter-organisational network structure is considered an evolving and dynamic systems that offer an opportunity for cooperation and allows various interest groups to integrate and adjust to ever-changing circumstances. This depends on the relationship between factors that create a network, such as actors, knowledge, resources, tasks, and organisations, and several networks can emerge from any complex environment.

2.6.1 Relevance of Social Network Approach in Management

Social network theory offers a theoretical perspective on the changing behaviour of agents as a result of the influence of emerging relationships between agents in a network. The focus is on social identity, as well as the knowledge or awareness of an individual that they are members of a particular social group (Easley and Kleinberg 2010; Tajfel 1972). The theory provides a framework for developing methods that can be used to map and analyse the disaster management system network by focusing on understanding the behaviour of people and groups as they form bonds with each other. Primarily, the theory's fundamental concepts are useful for building strategies and developing processes and measures to prevent and cope with disasters (Fioretti and Visser 2004; Lalonde 2007).

The underlying assumption, in theory, is that individuals connected tend to behave uniformly. Firstly, it influences loyalty. Secondly, it is a critical factor in determining the degree of cooperation within groups and among groups. Thirdly, it depends on the performance of individuals in a disaster management system, in most cases, corresponds with their social identities.

Accepting the proposition that connected people behave similarly, Miles (2012) summarises that members act more collectively in groups with solid team identities. One of the key concepts in the social network theory that underpins this idea is centrality (Coleman, 1990). Thus, centrality is defined as the most advantageous position an individual can occupy in a group. It leads to social capital, which measures how distant an individual or group is from the centre. Furthermore, Miles (2012) and Weichselgartner (2001) hold that relations between actors are influenced by the distance of each to the centre, as well as the distances between the actors.

Another critical factor is often referred to as embeddedness, which Baker and Faulkner (2002) described as the tendency of an individual to remain in a group, including the inclination to develop, sustain, and extend relationships over the long term. This inclination can comprise overt behavioural and cognitive inclinations, which create the network structure. The patterns

of centralisation and connectivity determine the complexity of the network. Thus, social network theory provides the foundation for detecting and analysing emergent social phenomena in networks that do not exist at the level of individuals embedded in the network.

Besides the ones discussed above, another equally important factor is the social utility of the group that allows the measurement of opportunities and limitations created by being members of the group. For example, Miles (2012) and White (2000) suggest that better opportunities are created when ties are unique. He emphasizes that practitioners widely accept social network theory as a reference base and an appropriate approach for determining the strength of social networks with respect to handling disasters. Due to this factor, practitioners often use Social Network Analysis (SNA) as a tool for disaster management.

Empirical research on network structure showed that a network comprises a group of nodes, or actors, and the relationship between these nodes (Borgatti et al. 2013). Afterwards, essential elements like nodes, groups, and actors are entrenched in the inter-organisational network's structure, providing the roadmap to disaster management. Therefore, the connection between the various elements in inter-organisational networks is based on their cooperation, which determines the level of information sharing, resource allocation, and collective action (Goldstein 2008; Kapucu 2008).

2.6.2 Resilience and Organisational Resilience Theory

It is critical to have an appropriate and comprehensive understanding of the concept of resilience in emergency management to be able to develop effective approaches that support management of, and recovery from, natural and/or man-made disasters. This section explores the concept of resilience and the application of Organisational Resilience Theory (ORT) as applied in emergency management as well as to reveal potential theoretical insights it might offer for achieving this research objective.

Bhamra's (2011) work defines resilience as the ability of systems to withstand disruption at the same time as effectively sustaining their basic functions and relationships. Within this definition, emphasis is placed on aligning resilience with the notion of endurance, where endurance refers to absorbing and recovering quickly from disturbances to maintain relationships among their components over time (Bhamra et al. 2011).

In the field of disaster management, Norris et al. (2008) suggest that resilience can be defined as the ability of systems, communities, or organisations to withstand, absorb, accommodate,

adapt to, transform and recover from hazardous events. Resilience requires multiple factors to work collectively to withstand and recover from adverse events (Tierney and Bruneau 2007). According to Tierney and Bruneau (2007), resilience involves physical, social, economic, and environmental components encompassing multiple aspects that play a vital role in supporting communities to effectively handle disasters (Tierney and Bruneau 2007).

ORT offers a comprehensive framework for the evaluation and assessment of an organisation's ability to withstand and cope with different types of disruptions, regardless of whether they are anticipated or unexpected (Hollnagel and Woods 2006). Organisational resilience consists of several essential components including risk management, adaptability, resource allocation, planning, preparedness activities, capacity building, and continuous learning and development (Ponomarov and Holcomb 2009). The first step typically taken by resilient organisations revolves around the successful identification of potential threats to organisational stability, which has been pointed out by Ponomarov and Holcomb (2009) in their theory on resilience. Organisations should identify, assess, and prioritise risks to create effective mitigation and contingency plans (Ponomarov and Holcomb 2009). Typically, organisations characterised by resilience exhibit notable agility and flexibility evidenced by their rapid adaptation to evolving circumstances through the modification of their strategies, operational procedures, and structural frameworks (Weick and Sutcliffe 2007). A key feature of this adaptability is that it enables such organisations to quickly respond to emerging challenges. Another critical aspect of organisational resilience is resource allocation. According to Ponomarov and Holcomb (2009), organisations must allocate their resources carefully, balancing both short-term recovery needs with long-term sustainability in their financial planning. Resiliency requires the establishment of crisis management protocols such as communication plans, decision-making procedures and coordination mechanisms that enhance capacities to swiftly respond to emergencies (Hollnagel and Woods 2006). Moreover, resilient organisations foster an environment of continuous learning and development including systematic performance analysis. By reflecting on both their successes and failures, resilient organisations identify potential areas for improvement, which makes a significant contribution to enhancing their overall resilience capacity (Weick and Sutcliffe 2007).

Furthermore, organisational resilience helps organisations understand how components interact within complex adaptive systems (CAS) to respond to internal and external disturbances (Urry et al. 2005). In relation to this, it should be noted how researchers often employ resilience concepts to model complex system behaviours under stress with the aim of

simulating various scenarios to anticipate challenges and devise appropriate responses (Holland et al. 2004). The implementation of organisational resilience principles within CASs helps enhance the capacity of the systems to adapt quickly to changing complex environments (Walker et al. 2004). Moreover, resilience theory provides policymakers and leaders with useful insights pertaining to the design of strategies to increase organisational robustness and adaptability (Folke et al. 2005). Relatedly, Comfort et al. (2010) have explained how an analysis of how organisational networks in CASs react to disruptions has the potential to assist with understanding interdependencies and communication flows. ORT has proven itself especially applicable in emergency management settings due to the dynamic interactions and inherent uncertainties within such systems. Significantly, it provides key insights into how organisations within emergency management systems adapt and evolve as disaster strikes, providing invaluable lessons.

Overall, it can be said that ORT provides a robust framework for comprehending and improving the resilience of CASs. It emphasises and foregrounds adaptability, learning, and networked interdependencies as critical elements to maintaining system integrity and functionality despite change and uncertainty. Various techniques involving system modelling, policy analysis and strategic planning play an important role in helping to manage risks while increasing sustainability within complex organisational environments.

A specific focus of ORT is the examination of the internal dynamics of organisations including leadership, culture, and decision-making processes with particular attention paid to adaptive strategies and learning from experience. Identification and understanding of organisational responses and how they adapt to changes, along with identification of internal resilience mechanisms within emergency management organisations are among the most noticeable benefits. Ultimately, ORT provides an analytical approach that is ideal for understanding specific organisational responses and strategies in disaster situations.

On the other hand, another theory of relevance but with a different focus is that of Social Network Theory (SNT), which explores relationships and interactions among various actors within an interdependent network. This network can include organisations, individuals and sectors alike. In particular, the network emphasises information exchange, resource sharing and collaborative efforts as critical aspects. SNT theory also provides an encompassing view of inter-organisational coordination and collective action during disaster management, thus providing a wider view of inter-organisational network effectiveness by examining coordination patterns among various stakeholders involved. Taken together, Organisational

Resilience Theory and Social Network Theory provide valuable insights into the resilience of emergency management systems. However, it should be acknowledged that while organisational resilience provides a closer examination of individual organisational behaviours and strategies, it might not fully capture the complexity of intersectoral coordination and the interdependencies among various actors in a comprehensive emergency management system (Hillmann and Guenther 2021). As the present research aims to assess the effectiveness of intersectoral coordination in emergency management systems, it adopts SNT as the primary theoretical framework because it offers a macro perspective of the interconnections and interactions within the entire emergency management network. SNT provides tools to analyse and understand the dynamics between sectors involved in emergency management (Borgatti and Halgin 2011). Moreover, SNT facilitates mapping and analysis of how information and resources flow within emergency systems which is crucial for effective coordination (Kapucu 2006). Through SNT, researchers can identify key actors or nodes within the network that play a critical role in coordination and communication, thereby informing the development of strategies to enhance system-wide resilience (Provan and Kenis 2008). Arguably one of the most vital characteristics is that SNT acknowledges the importance of social and cultural contexts, which can significantly impact intersectional interactions and coordination in emergency management (Aldrich 2012).

In summary, SNT offers a broader and more interconnected view of emergency management systems than ORT, thus positioning it as more suitable when understanding relational dynamics, communication patterns and network structures within complex disaster management systems. SNT also aligns well with intersectoral coordination during disasters, offering tools and perspectives for analysing relationships, resource flows and social and cultural influences on networks as a whole.

2.6.3 Social Network Research Approaches

From an academic perspective, it is noted that many researchers have proffered different approaches to the study and application of Social Network Theory in practice. For example, Kapucu et al. (2013) postulated that network usage is based on network application domains and classified network studies into three research fields. They further stressed that the first approach focuses on collaborative cross-sectoral networks, which were developed to improve cooperation among service providers, enhance the quality of services provided, and coordinate various services for the benefit of the public during disaster management. At the same time,

the second network research field focuses on policy network functions, as well as policy development and decision-making on the public agenda. The last network research field focuses on governance networks, underlining the effectiveness of network governance structure comprised of vital components like shared governance, lead agency governance, and network administration organisation (NAO). These basic components inherent in network governance provide the impetus to achieve network goals (Kapucu et al. 2013).

Still, scholars have identified two basic approaches to evaluating organisational network structure: network-level functioning, and governance (Kapucu 2008; Hagberg et al. 2011; Lane 2016). These approaches were developed to consolidate the research study done by sociologists investigating networks of individuals. Therefore, the development of the network analytical approach is to describe and explain network structural characteristics using such concepts as density, centrality, and structural holes (Burt 1992; Weichselgartner and Pigeon 2015; Wasserman and Faust 1994).

However, some scholars (Benjamin et al. 2010; Menya and K'Akumu 2016; Therrien et al. 2017) disagree with a few aspects of the network analytical approach due to its limitations, which focus more on analysing network configurations (the nodes and 'ties) but not the whole network nor its effectiveness in achieving the desired outcome. Typically, this approach is expected to yield findings that elucidate the actions of an actor, such as an organisation deeply entrenched within a network, as well as the influence of the network on determining the actor's capabilities and performance. Although it is observed that the choice of approach is vital in understanding the structure, attributes, and characteristics of a network, it does not explain the functioning and performance of networks (Kapucu 2008).

Moreover, more literature review showed network governance to be another type of network approach to inter-organisational structure. In this approach, a network is viewed as a form of governance that differs from the traditional bureaucratic hierarchy, as networks involve non-state stakeholders and are characterized by their basis of legitimacy, accountability, leadership, and more (Cutter et al. 2010; Vvon et al. 2008). However, researchers recognized network governance as an effective approach to the organisational structure because it explained the limitation of the first approach (network analytical approach) by describing the network as a form of social organisation. Thus, it is considered a part of the complete structural analysis. (Kapucu 2008). However, the next chapter provides a more detailed review of the network governance approach to organisational structure. Thus, this research study aligned with Kapucu

& Hu's view of using a network as a variable to analyse governance structure, the relations and composition of nodes and ties, and the effectiveness of its functions (Kapucu 2008).

Overall, this research focuses on developing a conceptual framework to assess inter-sectoral coordination's effectiveness in practical terms in providing public services through collaboration among inter-organisational networks involved in disaster management.

2.6.4 Network Analytical Approach

The focus of networks is often to: (i) outline the developed relationships existing in social systems composed of entities like actors or nodes and; (ii) at the same time, to highlight the means of connectivity between these organisations, known as ties or relations, that interlink the various organisations to create an interconnected web or a network. (Borgatti et al. 2013). The nodes have characteristics or 'attributes' that distinguish one from another. Similarly, relationships between nodes have characteristics (called ties or links), and the features/connectivity among network actors or nodes are called network structures (Borgatti et al. 2013). Network structures highlight the positioning of nodes in the network and the patterns of ties between nodes (Borgatti et al. 2013). Network structure is often considered less hierarchical and more flexible than organisational structures.

Furthermore, Borgatti et al. (2013) stressed that the indirect connection provides a means to separate network units that may affect each other. Some scholars see network structures as an integral approach to implementing public policy and administration since structural patterns influence network effectiveness (Van Der Vegt et al. 2015; Milward and Provan 1998). According to Hanneman and Riddle (2005), network structures are influenced by key aspects such as the number of member organisations and the size of the network, the level of ties and positioning of nodes, and patterns of connections among nodes. Therefore, the different roles an organisation engages in within a network can relate to the type of capital it draws upon and/or provides to the network (Hanneman and Riddle 2005).

Scholars have developed a network analytical approach to largely understand and conceptualise the size, scope, and characteristics of ties in a network structure. The network analytical approach's structural characteristics are density, centrality, and structural holes (Burt 1992; Tracey and Kuziemyky 2013; Wasserman and Faust 1994). According to Kapucu et al. (2013), such aspects make the network approach potentially useful to capture how inter-organisational emergency management systems engage disasters since networks can connect groups and

organisations across conventional boundaries of geography jurisdiction, organisational affiliation, sector, and expertise.

Social Network Analysis (SNA) can also be viewed as a tool to explore relationships among people in groups. Studies demonstrate that SNA can provide value-added when analysing individuals' and/or an organisation's social structure and interdependencies or work patterns. Besides, SNA is a collection of interdisciplinary methods that can be used to analyse social networks to predict the nature and/or impact of relationships among individuals and social groups on specified social phenomena (Butts, 2008). The methods are based on the core concepts of Social Network Analysis and have been applied in a diverse array of research activities, including disaster management studies (Magsino 2009; Varda et al. 2009). SNA methods are of two types, namely observational and analytical. Examples of observational methods include interviews (Freeman 2004). In practical terms, SNA methods can be applied at two levels, namely, the whole network level and the egocentric level, in which the focus is on individual actors (Butts 2008; Goswami et al. 2018; Thomalla et al. 2006; Varda et al. 2009).

An important aspect of SNA is the selection of location and respondents. Thus, researchers give notable attention to choosing suitable methods of sampling. For example, the purposive sampling method has been described as useful in studies concerning disaster resilience (Goswami et al. 2018). The usefulness of SNA in disaster studies is that it often begins by characterising or mapping the whole community's social networks before proceeding to the egocentric level in which influential individuals or social groups within the network are identified and characterised along with their relationships with key institutions in the network (Magsino 2009; Tatham et al. 2017). Some literature has utilised SNA analysis across each phase of a respective disaster/external shock, covering the whole timeframe, including from the pre- to post-disaster periods. Starting with the mitigation or risk reduction networks stage, preparedness networks, response networks, and recovery networks (Kapucu et al. 2013).

SNA methods are usually applied at two levels, namely the whole network level and the egocentric level in which the focus is on individual actors (Butts 2008; Varda et al. 2009; Goswami et al. 2018). The purpose of an egocentric study is to source additional information about the immediate neighbourhood of the network (Crossley et al. 2015).

SNA in disaster studies often begins by characterising or mapping the whole community's social networks, before proceeding to the egocentric level in which influential individuals or

social groups within the network are identified and characterised along with their relationships with key institutions in the network (Magsino 2009)

The analysis is conducted for each phase of disaster spanning, from the pre- to post-disaster periods. The properties of the whole network and the egocentric networks are assembled and analysed using both quantitative and qualitative methods. Therefore, SNA can be used in the current study to map out the Oman DMS network with the objective of showing the linkages between the various components. In addition, the SNA tool can provide understandable information concerning possible differences in the components or structure of the networks in two separate phases of disasters, such as the risk reduction phase and the response phase.

2.7 Network Governance

The theoretical review of this section provides an in-depth analysis of network governance as a strategic approach to governance in connection with disaster management from a diverse perspective. Network governance has been expounded by many authors as inherent in SNT, which is in relation to the preceding chapter that discussed the social network analytical approach to management, which focuses on the description and explanation of network structural characteristics. However, this part looks at the essential features of network governance legitimacy, accountability, and leadership as essential attributes of the governance process. Furthermore, this section clarifies forms of network governance that enhance management and highlights shared roles, lead agencies, and Network Administrative Organisations (NAO) that coordinate people in a more informal social structure.

However, theoretical analysis of network governance provides a more precise meaning and understanding of governance as a functional, practical, and conceptual approach to management, as well as an integral part of modern organisational structure, both in private and government systems. Therefore, many experts posited that network governance provides a familiar role for governance, which is to monitor and control the behaviour of management activities running organisations in representing and guarding the interests of stakeholders (Eisenhardt 2017; Jahre and Jensen 2010; Styhre 2002). On a similar note, Braun and Clarke (2006) viewed governance as “a process of coordinating and monitoring activities” that enables the existence of a collaborative partnership.

On the other hand, Milward and Provan (1998) describe network governance as “the use of institutions and structures of authority and collaboration to allocate resources and to coordinate and control joint action across the network as a whole” (p. 230). On their part, Benson and Clay (2004) stressed that “network governance is a “collaborative governance” framework used as a governing structure to coordinate public agencies that are collaborating with different non-state actors to have a collective decision-making process that is formal, consensus-orientated, and effort to accomplish and execute public policy or manage public plans or assets” (p. 544).

In literature, the term ‘network governance’ is generally interchanged with ‘network management, particularly in the public administration sector because the focus is on the organisational structure and coordination of its activities which is considered not different from the traditional arrangement of governance (Agranoff and McGuire 2003; Seeger et al. 2003). Also, within the framework of shared responsibilities, scholars use the terms “governance,” “collaborative governance,” and “network governance” interchangeably to interpret the same function and task.

Besides, some scholars study the concept of network governance to provide empirical proof of the effective use of network management in problem-solving for organisations in complex situations (Kapucu 2008). For Fioretti and Visser (2004), network governance explains the relationships between stakeholders based on shared gains, conviction, and acceptance.

2.8 Types of Network Governance

2.8.1 Network Legitimacy

Several researchers on network governance identified essential features inherent in network governance considered the main foundational elements in governance, one of which is legitimacy. According to Bergstrom et al. (2016), the significance of legitimacy in network governance is critical to the overall success of the approach to governance because the legal basis of the organisation structure is important and must be recognized. For instance, Foster (2005) and Samaratunge et al. (2012) asserted that legitimacy is the basis of network governance, which ensures the collaboration between policy decision-makers and those governed, who are the beneficiaries of the organisation’s structural arrangement.

Moreover, most scholars, such as Milward and Provan (1998), acknowledged legitimacy as the legal foundation for the organisation to be accepted and function successfully. However, acceptance of this fact makes some specialists divide network legitimacy into parts. For

example, Bigley and Roberts (2001) classified network legitimacy into internal and external. Therefore, internal legitimacy is the recognition within the organisation by members, while external legitimacy is the approval by outsiders who are not members of the organisation but accept the process and the system of governance.

2.8.2 Network Accountability

In literature, accountability is considered a vital component of the network governance process, which provides credibility and integrity in the organisational structure concerning planning and implementation of shared responsibilities. For instance, Sitas et al. (2016) and Rydin and Tate (2016) described accountability as a concept conscripted into governance that allows collaboration among organisations and interest groups, in which the organisation is expected to be transparent in its conduct in dealing with these interest groups, which attract either confident vote or questioning from them concerning its actions. Likewise, Smith (2019) and Schneider (1995) postulated that accountability is the essential requirement expected from someone assigned a task to explain its function to another person to reassure the trust and credibility of both parties.

Moreover, some researchers consider accountability as part of the ethical value in governance needed from anyone participating in shared responsibility to exempt the person from blame, untrustworthiness, moral burden, and discreditable actions (Rodriguez et al. 2016; White et al. 2004). In contributing to the intellectual argument concerning the significance of accountability in network governance, Schedler et al. (1999) viewed it as an inherent feature in governance that is crucial to the working and success of organisation policymaking and implementation to assuage stakeholders' fears regarding projects involving public sectors and private cooperation.

Other scholars (Northam 2014; Parsons et al. 2016; Ramalingam et al. 2008; Tompkins et al. 2008) argued that accountability is divided into vertical and horizontal within a network governance setting. They described vertical accountability as the stage of being answerable to the top rank in the organisation structure, while horizontal is being answerable to other stakeholders in the network system. In support of this notion, Twigg and Bottomley (2011) posited that vertical and horizontal accountability ensures ethnic norms, standards, and morals that require credibility in an organisational setup.

2.8.3 Network Leadership

Literature provided enough research materials on network leadership and management because of the attention it attracts and as a core element in governance, organisation structure, and functions. Bowen (2009) and Norris et al. (2008) viewpoint suggest that network leadership highlights the usefulness of a leadership role in an organisation and the sharing of power associated with such a role to enable control and sustain the corporation of all collaborative parties involved.

For the reasons stated above, many scholars emphasize that for any organisation to perform effectively and succeed, the role of leadership must be recognized and carved out to allow network governance to take root (Milward and Provan 1998). In essence, leaders are expected to find solutions to problems and create a power-sharing formula to ensure power balance to avoid possible conflicts for the sake of peace and cooperation needed to carry out effective network coordination (Kapucu 2008). Hence, leadership is necessary in the case of urgent crises and complex challenges that require a timely response (Boin and Bynander 2015; Normandin and Therrien 2016).

2.9 Forms of Network Governance

Nevertheless, despite the various descriptions and explanations provided by scholars on network governance. There is no empirical theory linked to the various existing forms of network governance, as most of the mechanisms discussed in the literature regarding shared or participatory, lead agency, and Network Administrative Organisation NAO (Provan and Kenis 2008) are specific networks developed to attend to certain activities performed for a particular network since networks consist of independent organisations and, thus, are essentially collaborative efforts (Eller et al. 2015).

The study of network governance is reflected in the works of scholars from diverse fields, such as Milward and Provan (1998), O’Leary (2014), and Chen et al. (2013). They all explained forms of network governance from separate perspectives to justify its inclusion in the governance process that helps coordinate shared responsibilities between public and private entities, as well as cooperation among actors involving organisational tasks that need the use of shared roles, lead approach, and as network administrative operation.

2.10 Management Activities in Network

The importance of management activities is critical to organisation set-up as pointed out by Kapucu (2008), which defined network management as the structure of any organisation, which reflects its relations and shares responsibilities with other interest groups on a joint designed plan, particularly during an emergency like a disaster. In their reckoning, Boin and Bynander (2015) posited that the management role in public and private organisations lessens the pressure and challenges from people. At the same time, subordinates and people look up to management for answers and solutions to any crisis or problem arising. For these reasons, scholars point out critical attributes of the managerial roles: confidence, competency, trust, accountability, and acceptable behaviours of network leadership.

However, a literature review on management activities in connection to network governance requires leadership input to perform ultimately tasks assigned by the management. From Agranoff and McGuire (2003) suggestion, management in organisational structure expects the leaders to possess certain qualities to achieve the specific assignment through constant interaction with stakeholders. Therefore, leadership encourages governance at the management level to establish and develop a working relationship with network members and stakeholders.

2.11 The Concept of Coordination

Disasters and emergencies are part of social issues in societies. Therefore, the ability of organisations and governments to respond effectively to disasters and emergencies is dependent mainly on initial social, political, and environmental conditions, including management systems in place at the time of an unfortunate event (Blackman et al. 2017; Fath et al., 2015; Schneider 1995; Kapucu 2009; Mendes et al., 2016; Ramalingam et al. 2008). Emergency management systems are complex, comprising several different actors working together in chaotic environments that affect their behaviour and performance. To achieve order in such a situation, it is essential that a specific individual(s) or a department in a government establishment act as a coordinating agent(s) (Abbasi 2014; Epstein and Axtell 1996; Kauffman 1993).

Contemporary studies exploring the concept of coordination have led to a general understanding that “at its core, coordination is about the integration of organisational work under conditions of task interdependence and uncertainty” (Faraj and Xiao 2006, p. 1156). Coordination enables a systematic approach to designing services and managing processes in emergency management systems (EMS). Coordination also involves monitoring and

evaluating services to ensure the delivery of quality services in all phases of EMS (Bahadori et al. 2015; Khankeh et al. 2005).

Bryson and Crosby (2008) defined inter-sectoral coordination in EMS as “the linking or sharing of information, goodwill, and good intentions; resources; activities, and power or capabilities by organisations in two or more sectors to achieve jointly an outcome that could not be achieved by organisations in one sector separately” (p.56). It can also be defined as the alignment of priorities and actions of actors across multiple sectors to achieve a common goal in the community (Comfort and Hesse 2007a; Herdiana et al. 2018; Parmar et al. 2007).

2.11.1 Overview of Coordination Theory

However, the theory of coordination provides an explanation of the coordination process in a social system, and it has become an integral part of management studies since the emergence of organisational science in the early 20th century. In a seminal publication, Lichtner (1924) discussed the importance of coordination in developing production processes in large organisations. Several theories have since emerged and continue to emerge within a body of scientific theory on coordination of activities of multiple actors in complex situations (Wolbers et al. 2018). While there may be subtle differences in approaches and assumptions, theories tend to converge on the idea of integration as the primary focus.

On the other hand, integration is defined as synthesizing different activities to become a set of unified and coherent actions (Fountain 2001; Wolbers et al. 2018). The theories of coordination seek to understand the dynamics regarding coordination with the aim of developing a framework for reorganising micro activities and processes to achieve positive outcomes at the macro level. They represent ideas in an emerging research area known as Coordination Theory (Gkeredakis 2014; Kaynak and Tuğer 2014; Majchrzak et al. 2012). Moreover, the relevance of Coordination Theory is that nearly all its different perspectives are applicable in emergency and disaster situations. It is recognized that operational goals are dynamic and often arise from local perceptions of given situations (Owen and Hayes 2014; Uhr 2009).

Coordination theories are often broken into two sub-categories, namely vertical and horizontal coordination. Both sub-categories are applicable in all phases of disaster management, including response and DRR phases. Vertical coordination is concerned with harmonising the activities of multiple organisations into a hierarchical structure characterised by the sharing of information, responsibilities, and human and material resources for a common purpose. The hierarchy is often based on the power structure and resource dependency (Kapucu and Garayev

2016; Kaynak and Tuğer 2014). For example, government departments are often called upon to provide leadership in vertical coordination. On the other hand, horizontal coordination seeks to integrate activities within the confines of a partnership arrangement between different organisations in a community. Inter-sectoral coordination is perceived to be horizontal. It focuses on the activities of organisations involved in the public, business, and non-profit sectors. Meanwhile, any partnership is voluntary, and there is a high degree of autonomy among participating organisations (Jung and Song 2014; Kaynak and Tuğer 2014).

It is noted that the focus of inter-sectoral coordination should be on how coordination happens and not on why coordination mechanisms work. Since approach to disaster management depends on the effective coordination of the situation to achieve successful results, not necessarily the mechanism described in coordination (Gkeredakis 2014; Okhuysen and Bechky 2009).

2.11.2 Conditions for Coordination

It is imperative to highlight Okhuysen and Bechky's (2009) main contributions to the debate concerning Coordination theory. Both scholars identify three integrating conditions: namely common understanding, accountability, and predictability. The three conditions mentioned in this paragraph impose demands on actors and can be satisfied by using a variety of mechanisms.

First, a common understanding is a prerequisite for coordination. It provides a shared holistic perspective of the task and an understanding of how each agent's input fits into the larger picture of goal achievement within an emergency. A common understanding is attained when three types of information are provided to all participants. Scholars like Cannon-Bowers and Salas (2001), Reagans et al. (2005), Rico et al. (2008); Okhuysen and Bechky (2009), outline the basic information as follow:

- i. The terms and references of the task, such as the strategies and actions required to achieve the goals and objectives of the task;
- ii. A list of all interdependent parties;
- iii. Details about the broader context in which the task is situated, such as organisational goals.

Overall, common understanding can be developed through formal and planned mechanisms or emergent transactions (Okhuysen and Bechky 2009).

The second condition is accountability, which ensures the sharing of responsibilities and clearly states each agent's duty in the task. Accountability in traditional coordination models helps recognize established formal authority by creating reporting lines. However, in contemporary horizontal coordination settings, accountability is a condition that promotes integration by making responsibilities visible to all interdependent parties, ensuring everyone is accountable for their actions. In the case of horizontal coordination, accountability can be achieved through lateral formal, informal, and emergent actions directed at the alignment of tasks assigned to interdependent parties across sectors (Ohrbuch 1997).

Then, the third condition, predictability, can be described as a situation in which everyone concerned understands the ordering and timing of subtasks within the larger task. Interdependent parties must be able to anticipate the actions of other agents in the system to plan and execute their activities, with the foreknowledge of what and when the actions of others are expected, individual agents can locate their assigned subtasks precisely and fit them correctly into the whole task (Gall et al. 2014; Rico et al. 2008). According to Okhuysen and Bechky (2009), predictability develops through the accurate definition and description of tasks, plans, and knowledge of the capabilities and preferences of other agents through emergent interactions.

Predictability and the other two integrating conditions are not mutually exclusive. They can all be present simultaneously or in pairs and are related and sometimes support each other. For instance, accountability may support predictability in a natural disaster such as a hurricane (Boin and Bynander 2015). Therefore, integration conditions are necessary but not sufficient to ensure effective coordination. Instead, effective coordination requires appropriate coordinating mechanisms to implement integrating conditions (Okhuysen and Bechky 2009).

2.11.3 Coordinating Mechanisms

Malone (1988) and Noe et al. (2017) note that coordination comprises mainly information processing tasks. Coordination also involves monitoring, evaluation, programming, and sharing property rights. Other equally important aspects of coordination include residual arbitration and liaison. However, in practice, effective coordination requires that formal and informal mechanisms be put in place. Coordinating mechanisms as formal or emergent organisational elements that enable actors in a complex system to integrate their actions effectively into a collective performance. The elements may be structures and processes, including tools, technologies, as well as interactions between participants (Okhuysen and

Bechky 2009; Gimenez et al. 2017). Mechanisms adopted, as well as the implementation and practices in inter-sectoral coordination, vary across countries. As mentioned in Section 1 of this review, coordination in complex adaptive systems is influenced by initial conditions, including constitutional arrangements, existing institutions, and culture and traditions (Blackman et al. 2017; Fath et al. 2015; Kapucu 2009; Mendes et al. 2016). However, several well-documented types of mechanisms often feature in the practice of coordination. They include plans, rules, and regulations, routines, roles, objects, representations, and proximity.

Coordination mechanisms are purposive and focused on preparation for task completion. There are several ways in which plans, rules and regulations can assist coordination in practice. Firstly, they provide details of actions required for task completion, including protocols establishing the type of expertise required and the sequencing of activities (Faraj and Xiao 2006). In so doing, they inform individual agents on how and when to respond during task execution. Plans, rules, and regulations are also effective for addressing problems arising from interdependence like resource allocation, enhancing interaction among stakeholders to resolve conflict and ensure completion of tasks (Pinto et al. 1993). The common practice in this respect is to use well-developed schedules. Ballard and Seibold (2003) state that schedules provide temporal maps in which prescribed points in time are designated as references for the assessment and evaluation of performance (Ballard and Seibold 2003; Malone and Crowston 1994).

Besides, scholars recognize that objects like technologies and representations are some of the mechanisms used in coordination. Hence, they can be used effectively as instruments to transmit social and technical information, to mobilize agents and stakeholders into action. They also provide platforms on which agents and stakeholders can interact, share meanings, and align their activities. Clearly defined roles of actors can also be effective mechanisms for coordination in that they convey all the expectations required of them, thereby ensuring continuity and consistency of behaviour as tasks progress. Roles can be formally structured, but in emergency management systems, it is often developed during interactions (Okhuysen and Bechky 2009).

The use of routines as a coordination mechanism is widespread and can be traced as far back as when interest in coordination resurged in the early 1920s (Lichtner 1924). Feldman (2000) defined routines as “repeated patterns of behaviour that are bound by rules and customs” (p. 611). Feldman (2004) later conceptualised routines embedded in activities within complex adaptive systems as emergent and having social interactions with social meanings. Routines

can bring actors together, create shared understanding, and provide templates for completing tasks. Okhuysen and Bechky (2009) state that routines establish a sequence of activities for a task, thereby providing interdependent agents a way of tracking the progress of a task. Interdependent parties can also anticipate who is next in the sequence of activities.

Finally, proximity is another mechanism for coordinating activities in a complex system, such as an emergency. Although advances in technology can mediate distance, proximity in terms of visibility, physical interaction, and familiarity can still impact coordination. Through their physical or perceived co-presence, interdependent agents, as the task progresses, obtain immediate and first-hand evidence of what is going on and may be able to adjust instantaneously (Wilson et al. 2008).

2.12 Inter-Sectoral Coordination in Emergency Management Systems

Several researchers have stressed the significance of inter-sectoral coordination in disaster management. This is because inter-sectoral coordination involves aligning the actions of organisations from diverse settings to achieve common objectives. It is grouped into four classes of actions commonly referred to as the 'Four Cs (Kapucu 2006; Moynihan 2008):

- Communication
- Cooperation
- Coordination
- Collaboration

According to Comfort and Hesse (2007b), the fundamental activity in inter-sectoral coordination is sharing information through communication. However, inter-sectoral coordination depends on the Four Cs and the command structure in which the organisations interact (Al-Shaqsi 2011; Moore and Daniel 2003). Therefore, since it is a complex activity, successful coordination involves both the effective connection of experts and resources and the development of flexible routines that can address contingent problems as they emerge. For instance, the United Nations Office for Disaster Risk Reduction (2015) recommends that each country establish a coordinating platform at all levels. National coordinating platforms can be defined as forums or committees involving stakeholders with a principal lead agency across all sectors. For effectiveness, the forum must be supported with political commitment and the technical capacity to undertake disaster risk management. It should be fully participatory, with all stakeholders actively involved. In addition, it requires resource mobilisation capability.

Thus, inter-sectoral coordination aims to provide direction and leadership among collaborating organisations in different sectors. It involves goal decomposition, managing uncertainties, and regulating interdependencies (Bahadori et al. 2015; Gulati et al. 2012; Malone and Crowston 1994). According to Kozuch and Sienkiewicz-Małyjurek (2016), inter-sectoral coordination is “characterised by interdependence with simultaneous autonomy of functioning as well as settlement of collaboration rules utilizing negotiation and based on organisational and legal factors” (p.6). However, although the central themes of coordination revolve around leadership, standardisation, and direction, meanwhile, practical issues emerging in each phase may require different approaches. Organisations are involved at different levels of operation, including strategic, tactical, and operational levels; therefore, challenges for networks at each phase may be different. It explains why approaches to the notions of leadership, direction, and standardisation may be different at the response and DRR phases, as well as why this may result in differences in terms of complexity, intensity, and quantity of members in each network.

Gazley (2008) and Moreno (1941) assert that coordinated inter-sectoral action is required to manage complex issues and challenges associated with disasters and emergencies effectively. The coordination of human and material resources in a complex environment involving organisations from different sectors, jurisdictions, and professions is complex. It requires considerable effort and skills to develop a comprehensive EMS (Aghajani & Abasgholipour 2014; Comfort and Kapucu 2006). Furthermore, coordination is an ongoing process within EMS. It is context-dependent and is influenced by the dynamics of change in the external environment and the specifics of the entities involved in managing emergencies and disasters (Kozuch and Sienkiewicz-Małyjurek 2016; Malone and Crowston 1994).

2.12.1 The Role of Collaboration in Inter-Sectoral Coordination

Collaboration, in general, is the process of organisations facilitating or operating in networks to address common problems that would otherwise have been difficult or impossible to solve as individual organisations (Agranoff and McGuire 2003; Bossong and Hegemann 2015; Gazley 2008). Collaboration, which may be vertical or horizontal, requires establishing a purposive relationship in which mutual goals, resources, power, and capabilities are shared between stakeholders (Agranoff and McGuire 2003; Gazley 2008; Lawrence et al. 1967). Coordination is concerned with operational activities, while collaboration is a notion that focuses on strategic decisions. Therefore, inter-sectoral collaboration is defined as

“cooperation between different sectors of society such as the public sector, civil society, and the private sector” (World Health Organisation; 1998, p.15).

Moreover, it is ascertained that coordination is a crucial element of collaboration. Apart from the coordination of priorities and actions, collaboration involves the execution of multi-agency agreements between agents and the systematic sharing of human, material, and financial resources among agents (Waugh and Streib 2006). Besides, the usefulness of coordination in EMS cannot be overemphasised (Gazley 2008; Chen et al. 2013). After all, appropriate coordination mechanisms are essential for effective communication and engagement of all parties involved in disaster and emergency management processes. In particular, the readiness and quality of response to disasters and emergencies are dictated by the quality of inter-sectoral coordination in existence in the affected country (Aghajani & Abasgholipour 2014; Sievers 2015; Waugh and Streib 2006).

Therefore, the participation of all sectors at the professional level is often required in disaster situations. Hence the critical tasks involve inter-sectoral, multi-organisational, and inter-governmental coordination of response and recovery activities (Waugh and Streib 2006). Disaster preparedness plans must cut across jurisdictions and agency types to restore pre-disaster routines and functions in society as quickly as possible and expose the community to as little disruption as possible to the well-being of the people affected (Mojir & Pilemalm, 2016). Accordingly, the main objective of inter-sectoral coordination in EMS is to ensure that systematic and coherent structures and plans for disaster prevention, preparedness, response, and recovery are developed and implemented in an effective and efficient manner via collaboration (Christensen et al. 2016).

In addition to effectiveness and efficiency, the basic principles involved in inter-sectoral coordination include participation, consensus building, equity and inclusiveness, transparency, and accountability (The National Disaster Management Agency, 2017). It is essential that stakeholders across sectors collaborate and participate in an organised and well-informed manner. All stakeholders must be given the opportunity to engage positively in discussions related to EMS policy and program development. Indeed, the sustainability of policy decisions requires harmony and good working relations between sectors.

The principle of equity and inclusiveness requires that the interests of all vulnerable people in society are equitably represented in all decision-making processes, while the principle of transparency is concerned with open access to information and freedom to share information

among stakeholders (Dieperink et al. 2016; Haddow and Bullock 2003). Accountability is a principle that helps in sustaining the working relationship among sectors. Stakeholders and sector representatives must remain accountable to their individual organisations and sectors (Dieperink et al. 2016; Martinez and Jarillo 1989).

2.12.2 Implementation and Practices of Inter-Sectoral Coordination

Implementation in inter-sectoral coordination involves developing plans and schedules, rules, communication processes, and procedures for decision-making, including face-to-face and group meetings with diverse actors within an EMS. The main objective of the process is to integrate activities across sectors (Grandori 1997; Hatch 2018). The list of common coordinating mechanisms discussed above suggests there are three typical processes in the implementation of inter-sectoral coordination, namely standardisation, planning, and mutual adjustment (Hashemipour et al. 2017).

Standardisation involves the development of rules, regulations, and routines. This approach is suitable when the problems being addressed are repetitive and relatively stable. In contrast, plans are more useful in dynamic situations involving interdependent actors. In this case, plans are often presented in the form of schedules of actions. In more chaotic situations, such as in the unfolding of disastrous events, the common practice is to apply coordination by mutual adjustments. Furthermore, in practice, the use of the three types of coordinating mechanisms is also influenced by the structure of the interdependency. In the case of pooled interdependency, a situation in which many agents in the pool are interdependent, the standardisation mechanism has been found to achieve better coordination. However, in the case of sequential interdependency, planning is more often preferred in practice. Mutual adjustment mechanisms are considered best for reciprocal interdependency (Jung et al. 2019).

Coordination mechanisms must be supported by an appropriate coordination structure. In a seminal publication, Malone (1987) notes that the basic structure of coordination comprises decision-making and communication patterns. However, Schilling (2000) argues that in systems such as EMS that are made up of complex and dynamic elements, coordination structure should include an additional feature, namely modularity; the components of the EMS should be grouped into modules. In doing so, components can be separated and regrouped easily to respond as an adaptive system to environmental changes. This is the justification for network construction, as suggested by Malone and Crowston (1994) in Complexity Theory. Hence, all emergency networks are built around modules. Although initial network structures

of emergency systems are similar and are made up of decision-making and communication patterns as noted above, the structure is dynamic. It evolves according to specific challenges and problems encountered in the environment (Abbasi et al. 2018).

The structure of the network evolves to become more complex. Researchers and practitioners in the field of coordination are increasingly using frameworks based on Complexity Theory including the method of Network Analysis as tools for understanding and designing better emergent communication patterns in disaster and emergency systems (Abbasi 2014; Lenoir 2018). Network analysis methods are also used for assessing and evaluating the effectiveness of coordination mechanisms (Waugh and Streib 2006; Kapucu et al. 2013; Kapucu and Garayev 2016). Coordination and collaboration at the inter-sectoral level involve goal decomposition, managing uncertainties, regulating interdependencies, communication, linking or sharing of information, integration of organisational work, and the monitoring and evaluation of services.

2.13 Conclusion of Literature Review

The literature review underlines the significance of the research works of other scholars and experts concerning the subject. Thus, the researcher breaks this chapter into sections to give an overview of others' opinions relating to the different concepts and terminology used in the research. The sections comprise an analytical review of disaster management, inter-organisational networks, and network collaborative functions. In addition, literature on social network theory, network analytical approach, network research approaches, and network structures were reviewed.

Besides, other important concepts like the concept of coordination, inter-sectoral coordination, and network governance and its components like legitimacy, accountability, and leadership that apply to the research study were reviewed to provide more expansive hypotheses. All the theories analysed are unique with a consensus objective but different approaches to accomplish that objective. Thus, the social network is the main theoretical framework for this study, which does not undermine the usefulness of other reviewed theories. Furthermore, the social network theory is chosen due to the specific case study of the Omani disaster management system. Other concepts reviewed have shown their contributions to developing a theoretical framework for disaster management.

The various components of SNT laid the foundation for the effective use of the latest features in the Omani DMS. In practical terms, the Social Network Theory provides the foundation for developing the means of analysing the social networks in the system. SNA methods, based on the key concepts of Social Network Theory, have been used in similar disaster management studies, providing valuable insights into the nature and impact of relationships among individuals and social groups in diverse social phenomena (Butts 2008; Hedelin et al. 2017).

SNA can be an appropriate mechanism for identifying the strengths and weaknesses of the Oman DMS in all the DRR phases. The use of Social Network Theory will enable the researcher of the current study to identify all the relevant Oman DMS components, map them out, and develop a framework for assessing the Oman DMS. Coordination Theory provides an appropriate theoretical framework for inter-sectoral coordination in EMS based on complex adaptive systems' characteristics. The theory explains why effective inter-sectoral coordination is essential across all phases of disaster management. It also provides, in contemporary practice, a foundation for the development of frameworks for building and analysing the effectiveness of networks in EMS.

Inter-sectoral coordination in EMS is an inherently complex task because of the nature of the environment it is undertaken. There are diverse organisations across sectors and jurisdictions in EMS, working together in a chaotic environment. Although the ultimate goal is to mitigate risk, enhance resilience provide relief, and return to normality after disasters and emergencies, there are often conflicts in subtasks that may impact the attainment of the primary goal. By creating the necessary conditions and providing appropriate structures and mechanisms, inter-sectoral coordination ensures the alignment of the priorities and actions of all involved agents toward achieving the macro-level goal. Inter-sectoral coordination is an ongoing accomplishment that is not necessarily a top-down management exercise. It is concerned primarily with the horizontal integration of tasks assigned to agents from different sectors and is often emergent as interactions between interdependent agents occur.

The literature reviewed above provides valuable insights into how to conduct a study that investigates the form, nature, and effectiveness of a sector-based disaster management system. The next chapter uses the concepts presented above to develop theoretical and conceptual frameworks to understand, examine, and evaluate inter-sectoral coordination in general and in Oman in particular.

Chapter 3 Conceptual Framework

This study's conceptual framework explores the importance of incorporating pertinent concepts to analyse complex management issues like the ODM. The conceptual framework provides an overall view and approach to this research thesis. It developed and organised ideas based on a literature review of existing studies and theories concerning the subject under research. According to Rhodes (1988) and Hazy and Uhl-Bien (2014), a well-planned conceptual framework serves as a guide to response to a disaster, as well as the recovery phase involving public and private actors, using the “inter-sectoral coordination” technique as a tool.

This research study mainly discussed how government and non-governmental organisations respond to emergencies, using communication and other network tools to coordinate their activities. Thus, the primary focus in this section is to develop a practicable conceptual framework to explore the aim, research questions, and objectives of this research:

- i. To explore the possibilities of establishing an effective inter-sectoral coordination framework as an approach to disaster risk reduction and response in a complex management system.
- ii. To examine the reliability and effectiveness of existing complex inter-sectoral coordination and coordination mechanisms within each cluster and among all clusters recognised in the post-2010 Omani disaster risk reduction system,
- iii. To provide recommendations for inclusion in strategic and operational guidelines for both formal and informal inter-sectoral coordination in a reformed post-2010 Omani disaster management system, as informed by theoretical and empirical findings.

3.1 Significance of Conceptual Framework

Social Network Theory will provide a comprehensive approach that can be used to explain why inter-sectoral coordination is necessary, how it should be conducted, who is to be studied, and what coordination mechanisms are required (Pramanik et al. 2015).

The relevance of Social Network Theory when considering Oman’s emergency management is accentuated given the number, growing frequency and diversity of environmental disasters, like cyclones, severe flooding, and coastal erosion experienced by the country. The development of an effective inter-agency mechanism in disaster risk management is required. Repeated use of existing patterns and approaches to disaster response by the government has

not always been entirely successful or effective to date. This necessitates a re-examination of the traditional command-and-control organisational framework that has served as the foundation for disaster preparation and response measures in most countries worldwide. This is important since every risk puts the community at risk, highlighting the need for a more thoughtful response aimed at reducing the risk (Berchtold et al. 2020).

In particular, the case of Oman is appropriate since the conceptual framework identifies the Omani National Disaster Management System (NDMS) as a complex adaptive system that is not only malleable but also provides fertile ground for insights drawn from the Social Network Theory (Boersma et al. 2014; Paton and Johnston 2017). Social Network approaches incorporated in the conceptual framework of the thesis facilitate the examination of the efficiency and effectiveness of existing complex inter-sectoral coordination and coordination mechanisms within each sector and among all clusters in the Omani disaster risk reduction and response system (Magsino 2009; Varda et al. 2009).

The aim of the framework is to obtain a deeper understanding of the behaviour of agents due to the influence(s) of emerging relationships between agents in a network. The study will identify who the agents are and, when, and where the agents need to link and change their behaviour to enhance emergency management in Oman. An additional aim is to understand the social bonds that emerge in disaster situations in Oman and to identify who the actors are in each action (Butts 2008; Goswami et al. 2018; Varda et al. 2009). The answer in this section will also be used to evaluate the appropriateness and effectiveness of the allocation of tasks. Thus, in the context of disaster resilience in Oman, SNT helps not only to identify relevant social networks with stable and tangible actors but also potentially strengthening those networks through efficient processes of scarce human and material resource allocation to deliver more effective inter-sectoral coordination (Higginbottom 2004; Magsino 2009).

Coordination mechanisms in disaster response and disaster risk reduction can be identified in the Oman DMS in terms of regulation, leadership, standardisation, planning, mutual adjustments, and direction. Through a conceptual framework explaining the development of strong social networks, SNT provides a greater understanding of the 'who' and 'how' that can inform further enhancement(s) of disaster resilience in Oman. The framework also facilitates the identification of the nuances, similarities, and differences of network configurations responsible for disaster response and disaster risk reduction in Oman. It provides guidance for evaluating structures, policies, and actions in the NDMS especially the levels of action and the categories of influential variables in the system.

Inter-sectoral coordination in an Emergency Management System (EMS) is an inherently complex task depending on the environment it is applied. In EMS, diverse organisations across sectors and jurisdictions, work together in a disorganised environment. Although the collective goal is to mitigate risk, enhance resilience, provide relief, and restore normalcy after disasters and emergencies. However, there are often conflicts in subtasks that may disrupt the attainment of the main goal due to lapses in the implementations of tasks. Inter-sectoral coordination ensures the required structures and mechanisms are in place to connect all agents involved to identify priorities and action plans for achieving the macro-level goal.

Moreover, Social Network Theory provides a straightforward approach to explaining why inter-sectoral coordination is necessary, how it should be conducted, who is to be studied, and what coordination mechanisms are required (Pramanik et al. 2015). Inter-sectoral coordination approach is considered a continuous management process that concentrates mainly on the horizontal integration of tasks assigned to agents from different sectors and is often an intermediary channel that enables interdependent agents to interact.

Therefore, the conceptual framework adopted in this thesis is to provide an explanation to the research questions which are directed primarily towards exploring ways to improve inter-sectoral coordination for DRR and response in disaster situations in Oman. Thus, the basic concepts of Social Network Theory will be applied to the case of disaster management in Oman in terms of strategies, measures, and processes in place for response and disaster risk reduction. Figure 2 offers an illustration of the conceptual framework developed by research.

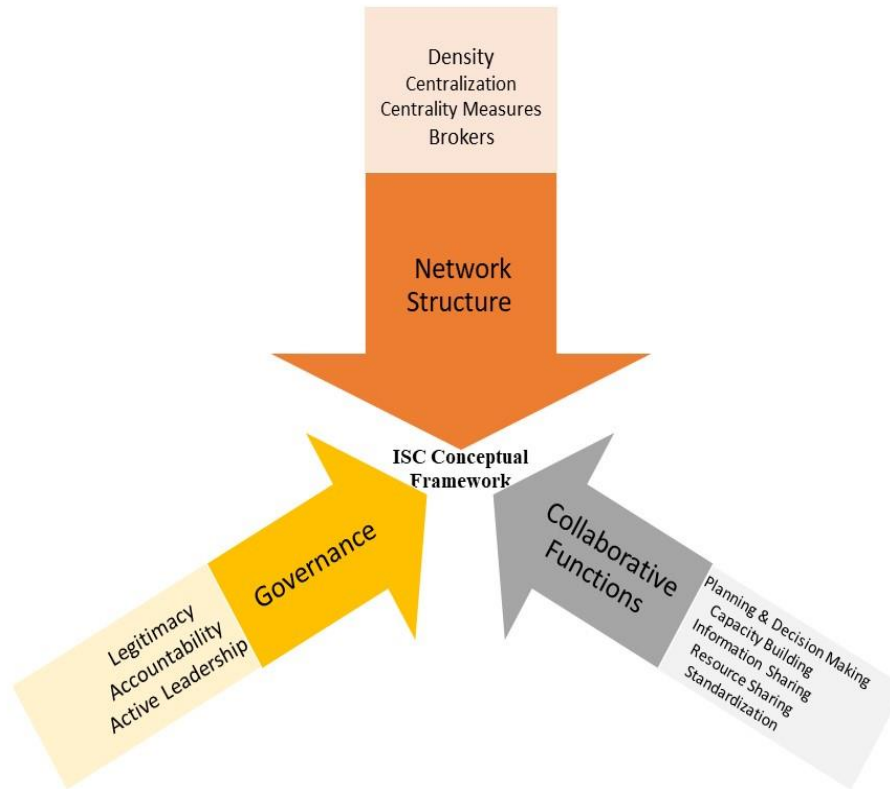


Figure 2: Conceptual Framework (Author 2022)

3.2 Social Network Theory

Social Network Theory (SNT) provides structure to analyse, measure, and utilize the level of connectivity between the agents and other components in the Oman DMS. It explains the ‘how’ and the ‘who’ by assuring us that social networking is an effective tool in disaster management since it promotes collaboration, collectiveness, and completeness. The use of SNT as a theoretical framework enhances the ability of the disaster manager to map and analyse the disaster management system network by providing a deeper understanding of the social bonds that emerge in disaster situations.

Besides, social networks have played major alternative roles in effective disaster management in all phases of disaster, such as generating and disseminating valuable information in the pre-disaster phase, planning evacuation(s) and sheltering, and mobilising volunteers in the response phase of a disaster (Hendrick 2009; Magsino 2009). SNT provides the ‘who’ when it postulates that the unit of study should not be restricted to individuals but should also include communities and institutions. After all, using SNT can help strengthen relationships among all actors within a certain framework in terms of service flows, information, and materials.

The conceptual framework in this study is analysed from three perspectives or lenses: network characteristics, governance, and collaboration functions. However, the emphasis is on network characteristics inherent in inter-organisational network dimensions that provide a comprehensive approach to explain why inter-sectoral coordination is necessary, how it should be conducted, who is to be studied, and what coordination mechanisms are required. Integrating the three inter-sectoral dimensions into a practical holistic framework to assume a model that considers the Omani National Disaster Management System (NDMS) as a complex adaptive system, although feasible using the insights obtained from the Social Network Theory.

Therefore, this section gives more prominence to network characteristics than governance and collaboration functions in assessing the effectiveness of inter-organisational networks and other different issues that need to be addressed in designing a valuable disaster management network. However, each dimension presents unique and valuable insights into all phases of disaster management, including disaster risk reduction (DRR) and response.

3.3. Identifying Features and Benchmarks of the Three Dimensions Applicable in the Oman Management System

This conceptual framework supports the development of pre-designed mechanisms that are flexible enough to adapt to fast-changing environments and effective for ad-hoc networking and improvisation. However, competencies, governance, capacities, and resources are the main features and benchmarks used in identifying the three dimensions of network governance, network characteristics, and network collaboration functions. However, further useful information is provided in Table 3 below which indicates what will be examined in this study and emphasizes the respective concept that needs to be considered to handle the growing complexity at any one point in the development process.

Table 3: Main Features of the Dimensions Approach to Disaster Management in Oman (Author 2022)

Network Governance
<ul style="list-style-type: none"> • ODM Network governance structure • ODM network legitimacy: legislation and policies addressing all phases of disaster management • DM network accountability system: Strategic plans at all levels for all phases, namely preparedness, response, and recovery • ODM Network leadership and management
Network Characteristics
<ul style="list-style-type: none"> • Risk Reduction NW attributes: size, closure; density, centrality & Betweenness, cliques, formalization, stability, integration • Response NW attributes: size, closure; density, centrality & Betweenness, cliques, formalization, stability, integration ▪ Communication patterns.
Network Collaboration Functions
<ul style="list-style-type: none"> • Coordination strategy • Collaboration Rules & standardisation • Joint Planning & Decision Making. • Capacity Building • Information exchange (situational awareness) Cognition (H). • Resource Sharing • Interoperability

Besides, the organisational structure of the three dimensions is designed within the inter-sectoral approach to disaster management to align with the conceptual framework. Below is a diagram showing the three dimensions in Figure 3.

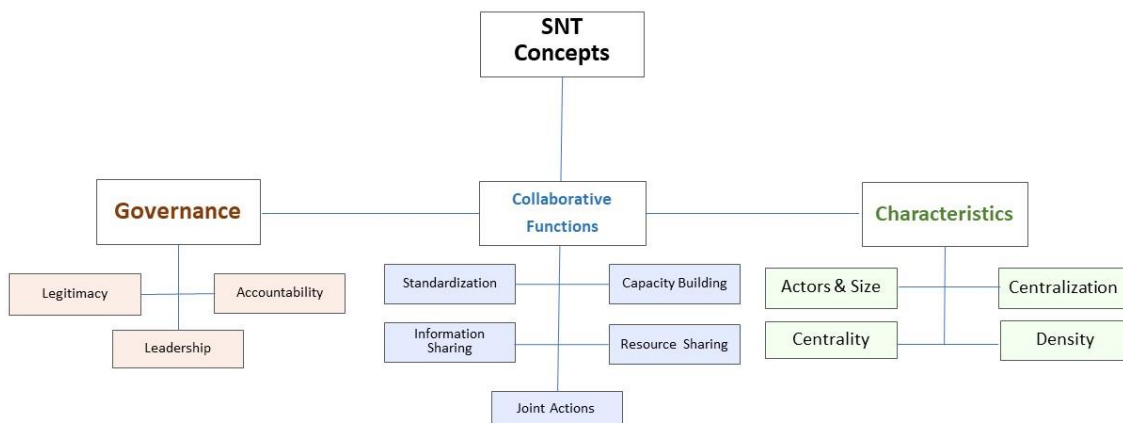


Figure 3: Three Perspectives/Lenses of the Research Conceptual Framework (Author 2022)

3.4 The First Lens: Network Characteristics

As explored in the literature review chapter, the focus of networks is to outline the developed relationships existing in social systems composed of entities like actors or nodes, referred to as organisations in this research. At the same time, examining the means of connectivity between these organisations, known as ties or relations, interlinking the various organisations to create an interconnected web or a network. (Borgatti et al. 2013; Kilduff and Tsai 2007). Network structures highlight the positioning of organisations in the network and the patterns of relationships between network member organisations.

Social Network Analysis (SNA) is an appropriate and effective analytical tool to be used in the current study. It will help map out the Oman DMS network and identify the lapses between the various components. In addition, the SNA tool can provide understandable information concerning possible differences in the components and/or structure of the networks in two separate phases of disasters, such as the risk reduction phase and the response phase.

Using Social Network Analysis (SNA), the research will provide an opportunity to conceptualize the size, scope, and characteristics of ties in the Omani EM network structure. The network structural characteristics to be assessed include density, centrality, and structural holes. This will be useful to capture how inter-organisational emergency management systems engage in disasters.

The risk reduction network and response network in Oman will be analysed using SNA to determine each network, closed, centralized, decentralized/brokered, and core-periphery characteristics.

3.4.1 Density

Network density determines the extent to which emergency management organisations are connected, how unified the network is, as well as what ties these organisations together (Comfort and Kapucu 2006). Furthermore, density shows how all network participants are interconnected and reflects network togetherness. Therefore, the network's density originates from the participants' connectivity in a coordinated network and is essential for an effective response to emergency management (Abbasi et al. 2018). Highly dense (or fully connected) networks are associated with accessibility to information is easier since all nodes are linked to others. The denser the network, the more ineffective there is in the paths along which information and influence can flow between any two actors. Thus, specific density levels are

required to facilitate effective communication and trust-building among organisations (Calkins 2015). Dense networks are perfect for coordinating activity among actors since everyone knows everyone's business. However, such networks are not efficient as they are very costly to establish and maintain. Network density itself might not be enough to explain network effectiveness, as it might be challenging to coordinate agencies in a highly decentralized network even with dense connections (Milward and Provan 1998).

The density of a network property is important to consider for two reasons. First, it can help us understand how connected the network is compared to how connected it might be. Second, comparing two networks with the same number of nodes and the same type of relationships can tell us how the networks are different (Scott 2000; Wasserman and Faust 1994).

3.4.2 Centralization

The measures of network centralization complement measures of network density (Milward and Provan 1998). Centralization determines the degree to which a few members hold the most connections in the network or the extent to which a network is dominated by the connections of one or a few organisations (Borgatti et al. 2013; Comfort and Kapucu 2006). On a similar note, a high centralization score represents a highly centralized network with few members holding the most central or dominating positions. A low centralization score represents a less centralized network with more members holding the most central position, or the network does not centre around one or a few key nodes.

Network centralization reflects the control and power structure of the network (Milward and Provan 1998). The researcher will assess network centralization and degree of centrality to measure whether there is a dominant lead organisation or administrative organisation in the networks. A centralized system and a dense network may improve service integration. In other words, a core agency can effectively coordinate a dense service network. In addition, a centralized structure allows the central agency to facilitate and coordinate the activities of member organisations in a service implementation network (Milward and Provan 1998). The central coordinators have the power to manage the operations and flow of information in the network (Abbasi et al. 2018).

3.4.3 Centrality

In emergency networks, the probable method of knowing the role of organisations is the use of centrality measures to understand which parts are responsible for a specific task like brokerage

and sharing of roles in the network (Moore and Daniel 2003). The centrality of nodes in a network impacts their leadership, satisfaction, and efficiency (Abbasi et al. 2018).

Four types of centrality measures are used in SNA: degree, closeness, betweenness, and eigenvector. Each of them analyses the position and power of network actors from a different perspective (Wasserman and Faust 1994). While Degree Centrality calculates the number of ties an actor has, Indegree centrality: the number of ties that an actor receives from other actors, and Outdegree centrality: calculates the number of ties that an actor sends to other actors (Borgatti et al. 2013). Centrality measures are indicators of the amount of collaboration and cooperation, connectivity, and communication that are objectives of creating network structures (Abbasi et al. 2018).

3.4.4 Core-periphery

Network structures close to centralization are found in the core periphery. It means a network with a core-periphery structure can have two kinds of nodes: core nodes and periphery nodes. The core nodes are interlinked, as well as with outside networks, while the periphery nodes are only linked to core nodes. A core-periphery network is a clumpy network with only one clump, which is the core (Borgatti et al. 2013). Therefore, what researchers consider an acceptable core/periphery network model comprises a completely-linked core and a periphery that is entirely bound to the core, as long there are no relations among the two nodes in the periphery (Borgatti et al. 2013). A central structure may facilitate coordination in a service implementation network, whereas, in a disaster management context, a core-periphery structure might work more effectively (Robinson et al. 2013).

In conclusion, the network characteristics guide the framework's development that focuses on each action's goals to determine the features that affect inter-sectoral coordination in Oman. Such features may include non-linearity, self-organisation, emergence, connectivity, and adaptiveness. Therefore, network characteristics comprise the essential elements that help analyse the relationship between theories in the application of social networks in this research. The basic feature of network characteristics is collaboration, which involves identity agents and their behaviour in ODMS. Then, the social bond that surfaces during disaster emergencies in Oman and identifying the actors in each action. Lastly are visualisation, centrality, and distribution in the management system. Thus, every theory has its features, and the features of network structure are the characteristics that determine the performance in disaster management.

3.5 The Second Lens: Network Governance

In answering this salient question, the basic concepts of Social Network Theory will be applied to the case of disaster management in Oman in terms of strategies, measures, and processes in place for emergency response, and disaster risk reduction. On the other hand, network governance will explain the emerging forms of participation within the OEM system and develop an effective leadership structure that enables effective participation in all phases of the disaster management system in Oman. Network governance provides the framework for understanding the ‘what’ in this study by explaining the tenets of network governance i.e., legitimacy, accountability, and leadership in the Oman situation.

3.5.1 Legitimacy

Network legitimacy is assessed by evaluating the level of acceptance of a pattern of governance; clear directives, goals, ethics, moral values, and intentions as necessary qualities for the organisation involved in governance and the society its functions (Kapucu 2008). Too, inter and external legitimacy is assessed by the recognition within the network by its members, and the approval by outsiders who are not members of the network but accept the process and the system of governance. In assessing legitimacy, legislation, policies, and frameworks to enhance and legitimize NW functions are evaluated. This includes a network structure/framework that encompasses various administrative and functional levels exist. Examples of Structure or framework are mitigation structure and response framework.

The existence of a common mission and goals, integrated activities, and a clear network structure is assessed. This includes an endorsed cross-sector strategy or program that aims at enhancing public service provision. Another critical aspect related to network legitimacy is whether it has a social identity and public presence (public outreach program), the willingness of other networks or institutions to partner with and enhance network functions, and community support by direct participation in network efforts, provision of donations, or approval/satisfaction of NW activities. Finally, legitimacy can be assessed by whether the network has an Adequate financial budget for emergencies at all levels.

3.5.2 Accountability

Network accountability is assessed by evaluating the level of credibility and integrity in the organisational structure concerning the planning and implementation of shared responsibilities. This includes whether networks have clearly defined roles and responsibilities of agencies in

each sector, the existence of administrative and civil service Laws, Policies, mandates, by-laws, MOUs, international abiding Agreements, and contracts, etc. Accountability is assessed by determining the level of transparency and accountability in human and material resource allocation, whether administrative system policies, structure, professional performance assessment system, and auditing mechanisms exist. This includes a network performance assessment system, After Action Review Reports, Network satisfaction surveys, etc.

3.5.3 Leadership & Management

An integral part of assessing network governance is identifying its governance structure; lead organisation, (NAO), or shared governance. Network leadership is assessed by its capability to develop relations, connect its members, and coordinate organisational activities to ensure interpersonal communication skills and synergy in the working environment or when performing shared responsibilities. Whether the network has a solid administrative process, problem-solving, control behaviour, and pursuing a unified task to accomplish the same objectives. This includes network leaders' ability to find solutions to problems and create a power-sharing formula to ensure power balance to avoid possible conflicts for the sake of peace and cooperation needed to carry out effective network coordination or the Presence of boundary-spanning leadership.

3.6 The Third Lens: Network Collaborative Functions

The third dimension of this conceptual framework is Network collaborative functions. Network collaborative functions will provide the foundation for identifying the coordination mechanisms available in the Omani disaster response and disaster risk reduction systems. Therefore, the objective is to identify the coordination mechanisms in disaster response and disaster risk reduction that are used in the Oman DMS regarding regulation, standardisation, planning, capacity building, and information management. Consequently, it will be helpful in the formulation of proposals for methods to make the disaster system more efficient and effective.

For instance, Jahre and Jensen (2010) proposed a cluster concept to minimise the effects of disasters. In assessing network collaborative function, it is critical to assess not only the types of collaboration, coordination, and integration functions that exist, but more importantly, whether such functions and interaction activities are legitimized collaborative among network members (i.e. information sharing, resources sharing, etc.) Whether there is authority to conduct various transactions and activities that are related to the network mission and goals,

accessibility to resources and competencies to pursue its goals, and the willingness of network members to actively engagement in sharing information and resources (trust).

3.6.1 A template for inter-sectoral coordination

The application of the three conceptual dimensions has a pattern as highlighted in Table 4 below. It provides a template for inter-sectoral coordination further presented in Table 5 The template aligns with the concept of Social Network theory comprising three dimensions: network governance, network characteristics, and network collaboration functions. The dimensions are embedded in the conceptual design of inter-sectoral coordination, as illustrated in both tables under discourse.

Table 4: Conceptual Framework of Disaster Management in Oman (Author 2022)

Lenses	Governance	Networks Characteristics		Coordination Process		
		Risk Reduction	Response	Risk Reduction	Response	
Indicators	<ul style="list-style-type: none"> ▪ NCCD Structure & Elements ▪ Structure of Authority & Collaboration ▪ Leadership & steering mechanism ▪ Modularity, Interdependence, & autonomy ▪ Legitimacy: laws, DM Strategies & Policies. ▪ Common understanding: (IMP). ▪ Predictability: (order of tasks) ▪ Diversity, Equity & Inclusiveness (representation), Embeddedness ▪ Trust building, capacity building ▪ Accountability: (NDM Plans roles & Resp, alignment of tasks, Performance Assessment) 	<ul style="list-style-type: none"> ▪ OEMS Network ▪ RR Network ▪ Response Network ▪ (NW attributes) size, closure; density, centrality & Betweenness, cliques, formalization, stability, integration ▪ Communication patterns. ▪ Management of Networks. ▪ RR. Specific Functions: (goals, risk analysis-mitigation projects +- budgeting-awareness- early warning (cognition), accountability, sustainability). ▪ Res. Specific Functions: (goals, planning- preparedness -activation- framing-mobilizing- synthesizing/integrating, accountability, sustainability). ▪ Accomplishment of NW goals. 	<ul style="list-style-type: none"> ▪ Collaboration Mechanism in RR & Res: <ul style="list-style-type: none"> • Coordination strategy (B-E-C) • Collaboration Rules & standardisation • Planning, Decision Making, consensus • Regulating Interdependencies: Mutual adjustment • Direction/Command & Control (V) • Knowledge management and Information exchange (situational awareness) Cognition (H). • Resource Sharing • Communications & Tech. • Joint actions (integration of tasks) • Performance assessment (AAR) ▪ Emergent Mechanisms. ▪ Coordination Challenges and opportunities: (commitment to collective action, collaboration experience, Conflict management strategies, deal with power differences) ▪ Coordination Effectiveness (ability to integrate actions and resources) 	National		
				Governorate		
				Local		
	*conditions for coordination					

As summarised in Table 4 above, each concept of the three dimensions embedded in the Social Network theory: network governance, network characteristics, and network collaboration functions has a specific role to perform in the inter-sectoral coordination approach to Oman DMS. Moreover, lenses and indicators are used to assess the effectiveness of each dimension.

- **Network Governance:** Table 4 shows that approaching emergency management utilising the lens of network governance is guided and measured by specific indicators, which are: Structure of authority, collaboration, mechanism, and legitimacy. Also, DM strategies are driven by trust, accountability, and capacity building considered the basic yardstick for coordination in the disaster management system.
- **Network Characteristics:** using components on risk reduction and response columns in Table 4 to analyse ODMS through the lens of network characteristics is justified by certain indicators including network visualisation, density, centralizations, and various centrality measures.
- **Network Collaboration Functions:** Table 4 above further shows the approach to inter-sectoral coordination through the lens of the coordination process, which elaborates specific indicators that involve collaboration between risk reduction and response for effective and successful application.

3.6.2 Benchmarks

The benchmarks or criteria to be used in evaluation and assessments in this research study are presented in Table 5.

Table 5: Benchmarks/Criteria for Assessment of Inter-sectoral Coordination in Oman (Author 2022)

Lenses		Criteria
Governance	Legitimacy Is the network capable of gaining internal and external acceptance and recognition as a legitimate form of organisation??	Foundation administrative order/law (Clear role and functions). NW Strategy with common vision and goals. Network structure/Framework. social identity and public presence. Authority/legitimacy to conduct transactions.

Lenses		Criteria
		<p>Access to funds, resources, and competencies.</p> <p>Community support & other network engagement).</p> <p>Are collaborative interaction activities legitimized among network members?</p>
	<p>Accountability</p> <p>Does network have an accountability system that aims to reach the shared goals of the partnership, and benefit the organisations in the network, the network itself, and the community the network serves?</p>	<p>External accountability:</p> <ul style="list-style-type: none"> ▪ Administrative and civil service Laws, Policies, mandates, by-laws, MOUs, international abiding Agreements, and contracts, etc. ▪ Network policies and governance system, Roles, responsibilities, & expectations., Mutual aid agreements. <p>Internal accountability:</p> <ul style="list-style-type: none"> ▪ Administrative system policies, structure, auditing mechanisms, ▪ Public governance and auditing system, professional performance assessment system, ▪ Network performance assessment system, After Action Review Reports, Network satisfaction surveys.
	<p>Leadership & Management</p> <p>What type of network governance structure exists? What are the practices of leadership??</p>	<p>Governance Structure/Form:</p> <p>Shared governance - Network Administrative Organisation (NAO) Lead Agency</p> <p>Leadership Style and Practices:</p> <p>Does the network have a boundary-spanning leadership that connects separate actors and is capable of:</p> <ul style="list-style-type: none"> ▪ advocate and facilitate cross-sector collaboration. ▪ enhance cooperation among various actors. ▪ bridged disconnected organisations. ▪ coordinate network efforts including information and resource exchange.

Lenses		Criteria
		<ul style="list-style-type: none"> ▪ instrumental in information flow and resource sharing. ▪ maintaining a dynamic and vibrant network
Collaborative Functions	Collaborative functions The existence of integrated Network activities	Coordination System/structure: The existence of a functioning coordination structure and mechanisms.
		Standardization & Planning: The Existence of protocols for joint planning and decision-making.
		Capacity Building: The existence of capacity and knowledge-building activities and programs.
		Information sharing: The existence of information sharing systems and mechanisms.
		Resource Sharing: The existence of Resource sharing policies and systems.
		Joint Actions: Common understanding, joint operational planning Continuous training to improve and maintain human resource capabilities. Incident Management system Command & control structure Predictability of tasks
Network Characteristics	Network Attributes	Density (connectedness): <ul style="list-style-type: none"> ▪ High density allows easy accessibility to information since all nodes are linked to others. ▪ Specific density levels are required to facilitate effective communication and trust-building among organisations.

Lenses		Criteria
		<ul style="list-style-type: none"> ▪ Dense networks are perfect for coordinating activity among actors. ▪ Network members are highly connected.
		<p>Centralization (cohesiveness)</p> <ul style="list-style-type: none"> ▪ Network centralization reflects the control and power structure of the network. ▪ A centralized system and a dense network may improve service integration.
		<p>Centrality:</p> <ul style="list-style-type: none"> ▪ The presence of a central power point, whereby key players, brokers, and boundary spanners are present. ▪ Central coordinators are empowered to manage the operations and flow of information in networks. ▪ Centrality measures are used to identify the specific task of each sector.

3.7 Conclusion

This chapter introduces and analyses conceptual frameworks related to intersectoral coordination in general and its application in Oman. The conceptual framework used in the research is based on Social Network Theory (SNT), which serves as the foundation for understanding and improving disaster management and response in Oman. The goal is to enhance coordination between sectors for disaster risk reduction (DRR) and response.

The SNT-based conceptual framework addresses key questions about intersectoral coordination, including how it should be conducted, who should be involved, and what coordination mechanisms are necessary. It focuses on network characteristics and collaboration functions as essential components for effective coordination in the Oman Disaster Management System (ODMS). The framework considers ODMS as a complex adaptive system and offers insights into differentiating disaster response and disaster risk reduction in Oman. Table 6 below highlights the purpose of the questions discussed in the approach to inter-sectoral coordination in disaster management.

Table 6: Summary of the purpose of How, Who, and What in the CF (Author 2022)

How?	The How will explain the use of the conceptual framework as an analysing tool in inter-sectoral coordination to provide effective communication and improve the post-2010 Oman disaster management system through network characteristics within the SNT.
Who?	The Social Network theory as the conceptual framework will determine the 'who' using the SNT to identify and explore the different clusters involved in developing effective inter-sectoral coordination in DMS.
What?	The 'what' will provide the answer to how inter-sectoral coordination can be effectively developed through network collaborative functions to improve the current Oman Disaster Management System.

Moreover, the diagram in Figure 3 in this chapter indicates the elements that comprise each of the three lenses in the research conceptual framework that constitute the SNT concept. These elements are considered the main actors in ODMS since they constitute the various inter-agencies that are involved in the Omani National Disaster Management System (NDMS), thereby making it a complex adaptive system, although feasible using the insights obtained from the Social Network Theory.

Thus, Tables 5 and 6 summarize the criteria and assessment involving the three-dimensional lenses in the conceptual framework for inter-sectoral coordination in Oman. The framework includes network governance, network characteristics, and network collaborative functions as its main dimensions. The factors used as criteria to evaluate network characteristics are density, centrality, and core-periphery structure, while that of network governance is legitimacy, accountability, and leadership structure. Also, strategic collaboration and coordination functions such as information and resource sharing, capacity building, standardisations, and task integration are the core criteria in assessing network collaborative functions.

The key characteristics of Social Network Theory include nodes (representing individuals, entities, or organisations) and ties (describing connections between nodes), as well as interdependencies and interactions through collaboration within the network. Visualization, centrality, and distribution are also important elements of SNT in the management system.

On the whole, the conceptual framework presents the Social Network Theory as a valuable tool to approach and analyse in order to understand and improve intersectoral coordination in disaster management. By focusing on network characteristics and collaboration functions, the conceptual framework offers insights into enhancing coordination and resilience in the Oman Disaster Management System

Chapter 4 Methodology

This study's research method outlines how the case study on Omani disaster management is carried out within a specific period, 2010-2020 to validate the rationale behind the approach to the research. The timeframe of this research justifies the reason for the selected documents analysed, which were current and relevant to provide explanations for the set objectives of this study. Moreover, research is designed to answer descriptive and explanatory questions. Descriptive questions are mainly concerned with issues such as 'Who,' 'What,' 'Where,' 'How,' or 'When.' In contrast, explanatory questions seek answers to questions that start with 'Why' (Clark and Creswell 2010; Saunders and Lewis 2012; Thomas and Hodges 2010). This research thesis includes descriptive and explanatory questions in line with ethical practice. This chapter presents the philosophical approach, aims, and objectives, as well as describes the theoretical basis and conceptual framework that necessitated the methodology adopted in this research.

Generally, two broad approaches to research study are available in the social sciences: quantitative and qualitative. Quantitative research is concerned with causal explanations and is based on the notion that the social phenomena under investigation are quantifiable and measurable. The assumption is that findings can be represented using numerical terms. The quantitative approach is often described as a realist or positivist approach (Quick and Hall 2015). On the other hand, the qualitative approach allows the researcher to gather information through participant observation, focus groups, interviews, and questionnaires. This allows participants to write descriptively, field recordings, documents, and case studies, and the data are often nonnumerical (Silver and Lewins 2014).

This study is conducted within the qualitative research paradigm using an inductive approach, instead of deductive. The reason behind the choice of the inductive is that it permits a researcher to conduct in-depth analytical reviews of raw data leading to the development of models and concepts through interpretations extracted from the raw data. Unlike the deductive research approach, which depends on facts, knowledge, or other information already in the public domain to arrive at a valid conclusion. As a result, many researchers use the inductive approach to identify links between findings and the research objectives to ensure validity and reliability (Strauss and Corbin 1998). Besides, the core features of the inductive research approach, such as allowing open and explorative research questions, as well as not permitting pre-determined

hypotheses but a desire to discover something new, are now the guiding principles in numerous research studies.

4.1. Types of Research Approaches

A qualitative research method is classified into the following types: ethnography, phenomenology, grounded theory, narrative research, discourse analysis, and interpretive research (Creswell 2014). Besides, the various types of qualitative research methods differ in approach to research study, which depends on the procedure followed. The differences in types of qualitative research are attributed to a wide range of factors such as the epistemological stance of the researcher on the essence of knowledge and the extent knowledge can be acquired. Also, the researcher's view concerning the events in the social world and characteristics of participants in the research (Ritchie et al. 2013).

Regarding this research thesis, the interpretative approach is the primary method adopted to conduct the research. within the qualitative research paradigm, then uses the descriptive approach for statistics explanation. Both interpretative and descriptive approaches provide the impetus to conduct a thorough research investigation and interpret the findings and results without sentiment attached to the study.

4.1.1. Interpretative Approach

A qualitative interpretive approach to research study placed great emphasis on the concept of 'the human as an instrument' (Lincoln and Guba 1985). Hence, the main instrument for data collection is the participant. The approach insists that open-ended questions are prioritised over finite pre-designed close-ended questions when searching for a deeper understanding of social phenomena. This assertion is based on the interpretive idea that researchers can produce knowledge by exploring the meanings and interpretations people attach to actions and events in the social world (Ritchie et al. 2013).

Interpretivism holds that contrary to the case in natural sciences, humans interpret the world around them and obtain different assumptions they act upon, thereby opening up the possibility of multiple laws of human behaviour (Thorne 2016). Therefore, it has the potential to offer unique benefits in this study, which focuses on social structures existing within the Oman disaster management system. Practically, the interpretive approach is helpful in situations when

applying theories may prove problematic because of limited empirical evidence and the uniqueness of the context of the study (Thorne 2016).

The Omani society is exceptional in culture and political dispensation (Khalifa 2019), although few studies have been conducted on the existing Oman disaster management system (Al-Manji et al. 2020). However, this particular study research is conducted from a different perspective to uncover new issues that may require further research. Besides, it can offer a more precise explanation of how relevant authorities can develop necessary interventions in the Oman disaster management system.

Conversely, the interpretive research approach has its significant benefits and disadvantages, which this study acknowledges. The benefits of the interpretative approach are: It offers the opportunity and potential for reformulating the researcher's past knowledge and understanding within the research process. The interpretative research approach provides flexibility and the generation and processing of data. It does not seek to support or refute specific ideas; rather, it seeks to advance knowledge and understanding (Callaghan 2016). Besides, it allows the analysis of data at both the descriptive (surface) and interpretive (deeper) levels, as well as the ability to weave historical context and theoretical underpinnings into a cogent narrative, particularly inherent in interpretative qualitative research.

Also, the shortcomings in interpretative research are identified. First, the process is time-consuming and resource intensive. Most times, it requires a well-trained research assistant is required to conduct interviews and gather qualitative data across several groups and organisations in the social system (Teherani et al. 2015; Thorne 2016). So far, this case study was different, and the necessity to employ an assistant did not arise since the whole interviews were solely conducted by this researcher. On the other hand, the emergence of the coronavirus pandemic during the course of this study posed a challenge to conducting the interviews. As a result, the interviews had to be conducted with the additional burden of taking mandatory safety precautions such as social distancing, wearing masks and other personal protective equipment, and conducting symptom and temperature check protocol.

Secondly, in the interpretative approach, the participants may have different understandings of the phenomenon being studied, which undermines the credibility of the research study. They may also have different motives for participating in the study, resulting in challenges in reconciling the perspectives. Despite these methodological challenges, the researcher believes

that the benefits outweigh the disadvantages since the issues can be addressed using valid and reliable research instruments to support the claims.

4.1.2. Descriptive Approach

The descriptive approach is an alternative to other approaches to research, it helps provide a detailed description of statistics to summarise features from a collection of information obtained from interviews, documents, and correspondences obtained from the NCEM. The statistics include percentages, ranges, and frequency distribution. Creswell (2014) states that researchers may use a mixed method design that combines philosophical assumptions in quantitative and qualitative research. The process is also known as triangulation, and it enables researchers to make up for the weaknesses or biases of each approach (Creswell 2014; Olsen 2004).

This study will use the methods of descriptive statistics to extract information from data obtained in surveys and document reviews on existing inter-sectoral coordination and coordination mechanisms within the post-2010 Omani disaster management system. Therefore, the researcher analyses it to complement the interpretive approach. At the same time, it supports the study by surveys and documents to show a deeper understanding of the nature, uniqueness, and complexity of a phenomenon that would not have been possible by generalising and using a single universal law for human behaviour.

4.2. Methods

This section explains the methods used in the research design for this study. The main interpretive method adopted is the semi-structured interviews complemented with literature reviews and document analysis. The triangulation approach to data collection and analysis was also employed, including the multivariate (statistical) analysis of data retrieved from multiple sources. The analytical approach is the process-tracing method, which is based on the thematic analysis of the semi-structured interviews conducted in Oman, which included senior decision-makers who have had direct experience working on the emergency management system at different government levels, including NCEM, sectors, GEMCs, and WSDCs. This approach would enable the researcher to explore useful information retrieved from the 48 interviewees who have anonymously shared their knowledge and views on questions related to the Omani EMS.

4.2.1. Semi-structured Interviews

The structure of the interviews in this research is based on four themes: the governance system of the EMS, the structure of relations that exist between emergency system member agencies in response and risk reduction phases, as well as the coordination and collaboration functions that exist among EM members in response and risk reduction phases, what measures and mechanisms should be implemented to enhance coordination and collaboration in EMS? Additional information is contained in the Interview Guide (see Appendix 2) that formed the basis of general statistical findings.

Therefore, semi-structured interviews are a special kind of in-depth interview used to collect data on people's experiences, perspectives, and personal histories. Generally, interviews can either be structured (questionnaires) or unstructured. Structured interviews/questionnaires often feature closed questions and are commonly used in quantitative studies. In contrast, unstructured interviews are more flexible. The term 'qualitative interviewing' is often used in qualitative studies to refer to semi-structured in-depth interviews. While structured interviews or questionnaires are designed to provide broad surveys, semi-structured interviews place emphasis on a particular phenomenon's depth, nuance, and complexity (Adams 2015).

Semi-structured interviews facilitate the externalisation of the participants' inner thoughts and feelings. Therefore, it is consistent with the interpretive idea that knowledge can be constructed from participants' perceptions. Furthermore, since semi-structured interviews are open-ended, they do not come with pre-determined hypotheses, topics, or themes. Instead, the topics and themes emerge naturally as the conversation progresses, as expected in an exploratory case study (Kallio et al. 2016; Taylor et al. 2015).

Therefore, the choice method in this study was to use a special type of in-depth interview known as the 'Open Semi-Structured Interviews' (OSSSI) method. The OSSSI is appropriate for this study because it enables the researcher to explore the opinions and perceptions of respondents and allows for detailed investigations to uncover more information. It also gives the respondents opportunities to clarify their answers. With the OSSSI method, interviews are conducted with one respondent at a time (Johnson and Kangasniemi 2016; Kallio et al. 2016; Taylor et al. 2015). OSSSI allows for a free-flowing discussion that makes the respondent more at ease and provides more information. The questions asked in this study are presented in Appendix 1.

4.2.2. Document Review

This research study is on existing disaster management systems and explores ways to develop a more effective system. Thus, the study will not be complete without reviewing documents and archived records relating to disaster management in Omani. They serve as the primary sources of data in this qualitative research. The rationale for document review in this study is mainly to use the triangulation method to seek convergence and corroboration and reduce the effects of biases on the findings. For instance, through document analysis, the researcher can confirm which agencies play key roles in the disaster management system (Bowen 2009; O’Leary 2014). Thus, qualitative researchers view documents produced, shared, and accepted in communities as credible sources of social facts (Bowen 2009).

As regards this study, such documents include plans, guidelines, emergency management records, organisational and sector reports, program proposals, and press releases. These documents were retrieved from NCEM for the purpose of this research, including the ones linked to its various sectors and committees, online sources, public libraries, and organisational files. Specifically, the following documents were reviewed:

- National Emergency Management Plan (NEMP) (2018)
- Governorate Emergency Management System Guideline (2017)
- Sectors Emergency Management System Guideline (2017)
- Critical Infrastructure Sector Plan (2010)
- Incident Management System (2016)
- EOC Operation Guideline (2017)
- Response Teams Guideline (2016).

These documents were instrumental in gaining a comprehensive understanding of the Omani DMS, and in developing interview questions.

4.2.3 Benefits of Documents

There are five essential benefits to this study derived from using documents as data sources. Firstly, it provides background information relating to the historical facts of the environment in the participant's work. Secondly, the reviewed documents provide insight into the contents of the questions to ask participants in the interviews. Thirdly, the documents act as sources for supplementary research data. Fourthly, during the examination of the documents, the

researcher could track the changes and developments in the Oman disaster management system since 2010. Fifthly, the documents helped verify and corroborate data from other sources.

On the other hand, the challenges experienced in searching for documents include insufficient details, irretrievability, and biased selectivity. Insufficient detail refers to the documents being produced for specific purposes and not for research, as well as irretrievability which shows the unwillingness of organisations and institutions to make documents unavailable for review. Biased selectivity is concerned with the fact that documents are produced in line with the policies and procedures of institutions and are likely to reflect only their views. Overall, the documents selected for this study provide rich and valuable data for conducting thorough research. Figure 4 offers an illustration of the conceptual framework developed by research.

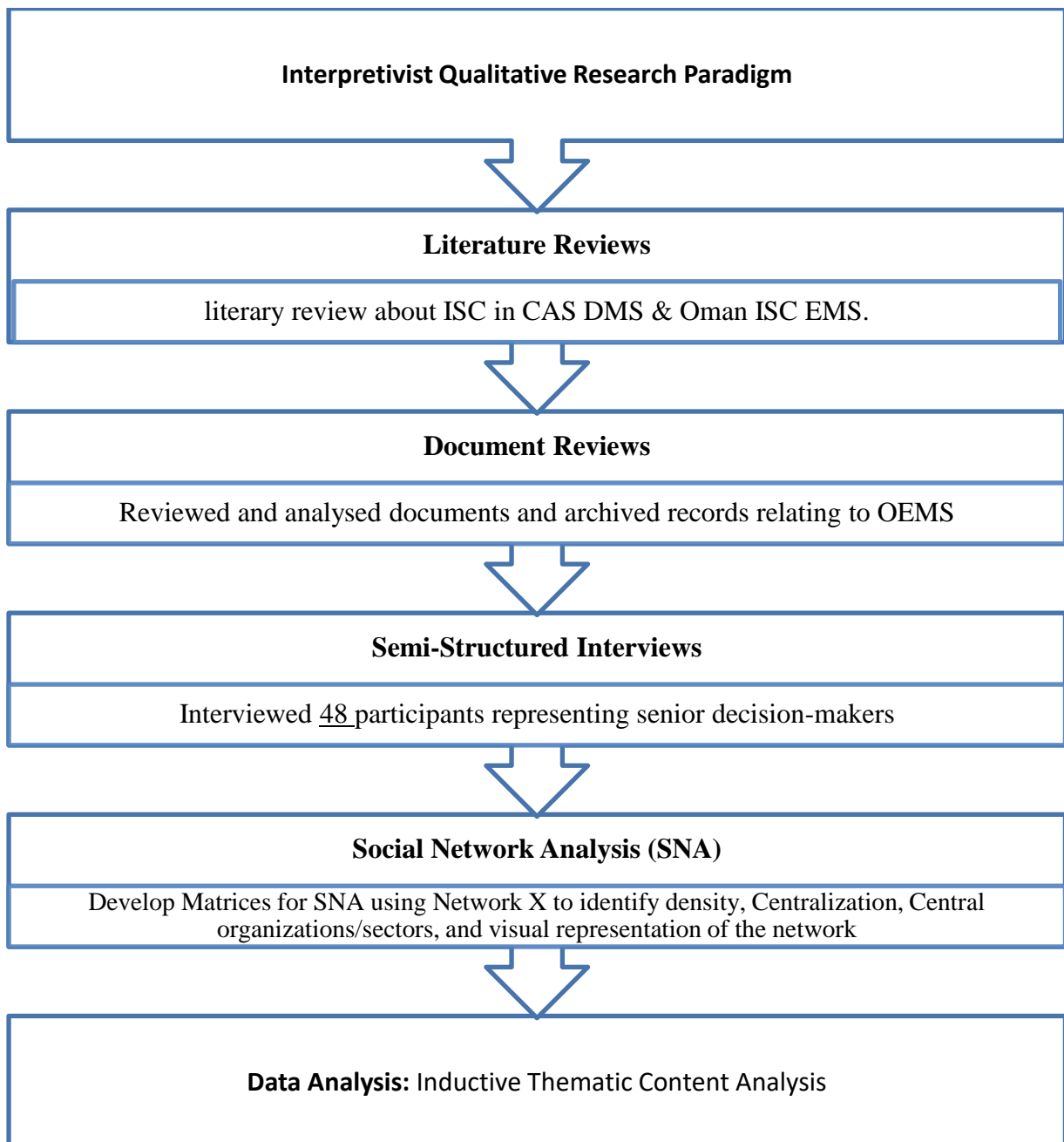


Figure 4: Research Methodology (Author 2022)

4.3. Sampling Techniques

Sampling in qualitative research differs from quantitative analysis in several ways, particularly in their epistemological stance that examines the methods and sources used in acquiring knowledge to form a logical conclusion to enhance the research's validity, scope, and methodology. Also, their ontological standpoint explores the subject matter the data forms the basis of the analysis, and focuses on ideas relevant to the research inquiry (Thomasson 2019). In contrast, the quantitative approach is more concerned with the sample being a good

representation of the study population. Qualitative studies are less concerned with the generalizability of results and focus more on investigating phenomena or situations with contextual connotations (Bloomberg and Volpe 2012; Gentles et al. 2015).

According to Bloomberg and Volpe (2012), sampling in qualitative research is purposeful and non-probabilistic. The researcher selects specific participants for specific purposes to pursue the study's goals. In addition, the type of sampling employed is based on the topic of investigation and the methodology adopted. Therefore, this sub-section of the study presents the underlying principles and practices of qualitative sampling that guided this study.

The first factor to consider in a qualitative research sample is that it is not static or constrained by the initial conceptualisations in the study due to the dynamic nature of social phenomena and social settings (Bloomberg and Volpe 2012; Gentles et al. 2015). As an alternative, the sample may be emergent or recurrent, depending on how the phenomenon unfolds. Therefore, the study sample may be selected at the start of the study and then revised during the study.

Afterwards, many sampling methods include convenience sampling and purposive sampling (Bloomberg and Volpe 2012; Gentles et al. 2015; Etikan and Bala 2017). Convenience sampling is useful in cases where human or material resources, including time, are limited. It is a practical method in which the strategy is to select members of a population that meet some practical criteria, including willingness to participate, spatial proximity, easy accessibility, and availability for the study. Convenience sampling is also referred to as 'Accidental sampling' because participants meet the criteria in a particular situation or at a particular point in time and space (Etikan and Bala 2017; Gentles et al. 2015; Jorgensen 2015). While it may be cheap and readily available for researchers, convenience sampling has been criticised as fraught with bias and highly likely to yield weak results (Etikan and Bala 2017; Gentles et al. 2015; Jorgensen 2015).

On the other hand, purposive sampling is a more expensive endeavour. It involves a deliberate attempt by the researcher to identify participants with specific qualities and characteristics. The technique is also known as 'Judgement sampling' because the researcher is expected to make sound judgement in the choice of participants. The judgement invariably depends on the aims and objectives of the study. Hence, there are several strategies open to a researcher using purposive sampling, including 'maximum variation,' 'typical case,' 'extreme case,' 'homogeneous,' and 'expert sampling' techniques (Rai and Thapa 2015; Sharma 2017).

This study uses the Expert Purposive sampling technique in which the sample size was not predetermined but emerged from the adoption of Lynn’s model for content validity. The model rests upon the accessibility and agreeability of participants (Lynn 1986). To provide a comprehensive understanding of the whole chain process to determine how resources are shared and how effective leadership is in the ODMS. It is important to include participants who know what goes on in the organisations that make up the system and are professionally qualified to offer informed opinions. Accordingly, the sample included officials in leadership positions in each sector who have had practical experience with disasters in Oman. The sample also was chosen to reflect the three levels of disaster management, which are national, governorate, and local levels. This study assumes that no single actor can significantly influence the macro-outcomes of the system. However, each actor’s contribution at the micro level adds up and helps to determine the macro outcomes. Hence officials who have personal autonomy in exercising their duties and have good working relationships within and across organisations and sectors were included.

However, the category of interviewees were executive directors and senior officials, selected from records within the National Emergency Management Plan. This category of respondents was assumed to have the most accurate information about their organisations’/sector’s actual activities and more power to make decisions than others in their organisations. Table 7 below highlights the criteria for the inclusion/exclusion of interviewees.

Table 7: Inclusion/Exclusion Criteria (Author 2022)

Inclusion Criteria	Exclusion Criteria
<ol style="list-style-type: none"> 1. Expert in a key professional domain defines a sector in the Oman Emergency Management System. 2. Number of years of practical experience in Disaster Management. 3. Direct experience in a disaster situation that happened in Oman. 4. Holds a management position in an institution in the sector. 5. Has personal autonomy in the exercise of their duties. 	<ol style="list-style-type: none"> 1. Potential risks to the participant can be identified. 2. The anonymity and protection of the personal integrity of the participant cannot be guaranteed. 3. High likelihood of not being available for a follow-up

<p>6. Has good working relationships within and across organisations and sectors.</p> <p>7. Gives both verbal and written consent to participate in the study.</p> <p>8. Available for follow-up</p>	
--	--

4.3.1. Sample Characteristics

According to Cao and McHugh (2005), the researcher using the purposive sampling method only needs to focus on the research goals and tradition. Consequently, the researcher in this study planned to interview as many experts as necessary to provide answers to the research questions.

In this study, a comprehensive series of 48 interviews was conducted with officials from various tiers of Oman's emergency management system, including national, governorate, and local levels. Specifically, the breakdown of participants was as follows:

Emergency Management Authorities: A total of 7 officials participated from this category. This included two officials from the National Emergency Management Authority (NCEM) and five from Governorate Emergency Management Authorities (GCEMs). Among these five, three officials were selected from governorates with extensive disaster management experience (Muscat GEMC, Dhofar GEMC, South Sharqiyah GEMC), while the remaining two had comparatively limited experience. Emergency management authority officials at the governorate levels are in a unique position to discuss how local challenges affect emergency management. This includes dealing with geographical and socio-economic factors that influence the effectiveness of emergency responses and preparedness.

Sectors: In this category, 35 officials were interviewed. This group comprised 16 national-level officials, representing eight different sectors with each sector represented by two officials. Their insights reflect how each sector prepares for and responds to emergencies at a national scale. Additionally, 14 officials represented the four sectors namely Search & Rescue, Medical Response, Relief & Shelter and Critical Infrastructure were represented at the governorate level, specifically from the five governorates aligned with the emergency management authorities. Their insights offer a ground-level view of emergency management, focusing on practical aspects such as resource allocation, community engagement, first responder coordination, and immediate response mechanisms. Lastly, five officials represented the Relief

and Shelter Sector (Wilayat Social Development Committees) at the local level, unique in its operation exclusively at this level (Seeb WSDC, Salalah WSDC, Sur WSDC, Sohar WSDC, and Nizwa WSDC). Their unique local-level operation gives them a distinct perspective on community-based emergency management, focusing on community awareness, and immediate relief and shelter provision during disasters. Fig 5 is a map of Oman showing all the different Governorates and the Wilayats where the interviews were conducted.

Risk Owner Organisations: To enhance understanding of disaster risk reduction coordination, interviews were also conducted with representatives from six ministries. These ministries are designated as 'risk owners,' they have specific responsibilities in identifying, assessing, and managing risks associated with various types of disasters. The participation of these ministries is crucial for understanding how risk reduction is coordinated across different governmental layers and sectors. They play a significant role in policy-making, resource allocation, and implementing disaster risk reduction strategies.

The interviews were vital for gaining a holistic understanding of Oman’s emergency management system. The participant's perspectives provide a rich, nuanced view of how emergency strategies are implemented at the national, governorate, and local levels, highlighting both successes and areas for improvement. This level of detail is crucial for developing a well-rounded picture of the emergency management capabilities and needs within the country. The characteristics and distribution of the interviewees in this study are presented in Table 8 below.

Table 8: Characteristics Distribution of interviewees according to Category (Author 2022)

Category	Number of Interviewees	Reference Code	Total
Emergent Management Authorities	Two: Officials from the emergency management authority at the national level (NEMC)	A	7
	Five: Officials from emergency management authority at the governorate level (GEMC)		
Sectors	Sixteen: Officials representing sectors at the national level (2 participants from each sector)	S	35
	Fourteen: Officials representing sectors at the governorate level.		

	Five: Officials representing sectors at the Wilayat level (WSDC)		
Risk Reduction Organisations	Five: Officials representing risk owner organisations at the national level	R	6
Total			48



Figure 5: Map of Oman identifying the Governorates (World Atlas 2023)

4.4 Data Collection

Preparing for the interviews with senior Omani officials regarding the emergency management system required a meticulous and comprehensive approach. Given the complexity and depth of the topics involved, preparations for these interviews included:

4.4.1 Understanding the Omani Disaster Management System

The first crucial step to understanding the Omani emergency management system is conducting detailed and comprehensive background research. This was necessary before developing the interview questions and was carried out by the researcher conducting extensive research on Oman's emergency management system. This research included studying existing documents, policy documents, and reports that describe the structure and operations of the system. Following this, key areas such as organisational structure, existing emergency procedures, and previous responses to disasters in Oman were identified. From this understanding and building on the conceptual framework of social network theory developed as part of the literature review phase, a set of specific criteria was developed and used to explore and evaluate each aspect of the framework. These criteria formed the basis of the interview questionnaire. The interview questions were developed to explore the general functionality of Oman's disaster management system, its strengths, weaknesses, and areas for improvement. To analyse the emergency management governance structure in Oman and determine the roles of different government agencies and other stakeholders, a set of questions for semi-structured interviews was carefully developed. These questions were designed to be open-ended to allow for in-depth responses, yet they were structured enough to keep the conversation focused on relevant topics. The questions aimed to understand the hierarchical structure, decision-making and policy-making processes, and the role of leadership in emergency management in Oman. To explore coordination and cooperation during the emergency management phases, questions examining how coordination and cooperation are managed during the response and risk mitigation phases were posed to the participants. Moreover, the questions aimed at identifying key actors in each phase, understanding the roles, responsibilities, and interactions between these key actors including communication patterns and cooperation activities.

In summary, the structure of the interview questions for the research was based on four themes:

- i. Oman Emergency Management System governance structure
- ii. The relationship structure that exists among various organisations in the response and risk reduction phases.

- iii. The coordination and collaboration functions that exist among various emergency management organisations in the response and risk reduction phases.
- iv. Recommended Measures and Mechanisms that should be implemented to enhance emergency management coordination in Oman DMS.

4.4.2 Pilot Interviews

To refine the questions, a pilot test of the questionnaire interviewing a small group of individuals knowledgeable about Oman's disaster management system was conducted. The primary goal of these interviews was to assess and refine the interview protocol. This included evaluating the effectiveness of the questions in ensuring they can extract the desired information. Moreover, it was extremely helpful in identifying questions that may be confusing or leading so they could be asked in a clearer, more neutral way. Moreover, these interviews were essential in identifying potentially misleading or confusing questions, thus allowing for clearer, more neutral phrasing. Furthermore, the pilot interviews were instrumental in providing an estimate of the time required to conduct the real interviews, which was in turn important for scheduling and planning purposes. Patterns in how respondents understand and answer these questions were sought through recording and analysis of these interviews while also noting areas where they struggled or gave unexpected information. On this basis, some questions were refined and reordered to fit better into what the interviews needed to cover. This ensured that culturally sensitive and respectful interview questions were used. In addition to this, the pilot helped as some of these interviews were done via video call, thus requiring testing out the technical setup as well as addressing any related challenges arising from this mode of conducting them. Finally, for the researcher, pilot interviews became an opportunity for self-improvement and a means of enhancing skills in interviewing people and boosting confidence thereby making the actual interview sessions more comfortable overall.

4.4.3 Logistical Arrangements

In preparing for the interviews, a thorough preparation process was carried out that included careful planning and scheduling of the interviews as well as ensuring a dependable technical setup for recording the interviews. This action was taken in order to guarantee that the interviews were informative, efficient, and considerate of the time and expertise of the participants. Since the officials participating in these interviews are from different governorates and localities of Oman, travel and lodging arrangements were required in each governorate and

Wilayat visited. The limited availability of certain senior officials for interviews due to their busy schedules was a noteworthy problem during the phases of interview preparation and execution. Moreover, to ensure thorough data collection, this issue was addressed by implementing flexible scheduling and conducting follow-up interviews.

4.4.4 The Interview Process

Prior to conducting the interviews, a detailed information sheet was prepared and sent out to all potential interviewees. The document explained the study's aim, objectives, and their participation role. A consent form was included with the information sheet. The form outlined the voluntary nature of participation and the rights of the interviewees including the option to withdraw at any point without needing to provide a reason. The first communication with potential participants included a clear and concise explanation of the goals of the study in general but also of the interviews. To encourage open and honest dialogue, participants were reassured about the strict confidentiality of their responses. This assurance was crucial for fostering a safe environment where interviewees felt comfortable sharing sensitive information. Moreover, it was made clear to participants that participation in the study was entirely voluntary, ensuring that interviewees felt no pressure to participate and that they could withdraw from the study at any time without any obligation to provide a reason for their decision. The researcher also offered participants the option to have their interviews recorded. This choice was provided to respect their comfort level and privacy concerns. Throughout the data collection process, the researcher ensured compliance with BU ethical standards and guidelines, particularly in relation to confidentiality, voluntary participation, and informed consent.

For overall ease of communication and cultural relevance, the interviewees spoke Arabic, their native tongue. Each interview followed an interview guide comprising focus questions but also with room provided to allow the conversation to run spontaneously and to encourage officials to share their insights and experiences. This method allowed for in-depth discussion and follow-up on interviewees' interesting points. The duration of each interview ranged from 45-120 minutes, with the length dependent on the depth of the conversation and the interviewee's availability and willingness to share information. Some interviews were conducted in person while others were conducted via video conferencing, depending on availability and preference. Throughout the interview process, the conversations were carefully recorded either through

audio recording or meticulous notetaking to ensure that all information shared was accurately captured for later analysis.

COVID-19 restrictions posed some logistical difficulties, affecting the ability to conduct in-person interviews and potentially limiting the availability of officials for participation. To navigate this challenge, virtual communication tools were adopted for the interviews ensuring flexibility in scheduling to accommodate the constraints imposed by the pandemic. In addition, a thorough participant review process was implemented by providing each interviewee with a copy of the interview transcript. This measure ensured accuracy and gave participants the opportunity to verify their responses. Additionally, it allowed participants to complement their answers or provide additional insights to contribute further. This meticulous approach aimed to enhance the credibility and completeness of the data obtained during the interview process.

4.4.5 Post-Interview Process: Transcription and coding

Given that certain interviews were recorded, they were subsequently transcribed. Following this, it was also necessary for some interview transcripts to be translated into English.

During the analysis of the transcribed interviews in this research, a rigorous coding technique was employed to guarantee precision, structure, and efficient data interpretation. The specific coding methodology employed was informed by the concepts elucidated by Miles and Huberman (1994), who advocate for the utilisation of alphabetical codes. Adopting this type of coding is favoured because it facilitates a stronger, more instinctive link between the researcher and the data, hence improving qualitative analysis.

Every participant was assigned an alphabetical and numerical code based on their representation in the emergency management spectrum. This enabled a systematic and effective method of classifying the data, assisting in the future stages of analysis and interpretation. There were three groups of participants: participants from emergency management authorities; participants from various sectors; and participants from Risk Owner Organisations. These will be explained in more detail below.

The first group of participants was those from Emergency Management (EM) authorities. To differentiate each member within this category, a blend of alphabetical and numerical encoding was employed. Each participant was assigned a unique code, starting with the letter 'A' (signifying 'Authority') followed by a number. This system resulted in codes ranging from A1-A7, corresponding to the seven participants from EM authorities. As an illustration, the initial

participant from the EM authorities was assigned the code 'A1', the second participant was assigned 'A2', and so on, up to 'A7'. This code was consistently used throughout the data to represent insights and responses specific to this group, enabling a streamlined analysis of perspectives related to emergency management authorities.

The second group were participants from various sectors, which referred to those representing sectors such as the Early Warning Sector, the Critical Infrastructure Sector, the Search & Rescue Sector, among others. To distinctly identify each sector participant, a combination of alphabetical and numerical coding was utilised, similar to the approach used for EM authority participants. Each sector participant was given a unique code, starting with the letter 'S' (denoting 'Sector'), followed by a sequential number. This resulted in a series of codes from S1-S35 for each of the 35 sector participants. This classification facilitated the gathering and analysis of perspectives across a diverse range of sectors that interact within the Omani emergency management systems.

Next, there was the group comprising participants from Risk Owner Organisations. These participants are associated with organisations that are directly involved in managing and mitigating various risks and were key informants in this study. In order to clearly classify each of these participants, a comparable system of alphabetical and numerical codes was employed. Every member of the organisations responsible for managing risks was given a distinct code, starting with the letter 'R' (representing 'Risk Owner'), followed by a numerical value. This coding yielded a sequence spanning from R1-R6, corresponding to the six participants from these organisations.

The implementation of this coding system enabled the tracking of each participant's responses on an individual basis, which in turn facilitated a comprehensive and intricate analysis. This method offered a clear method to separate and refer to the data from participants in EM authority, the various sectors, or from Risk Owner Organisations, which is essential for doing comparative and thematic analysis. The utilisation of alphabetical and numerical codes enhanced a more instinctive interaction with the data. This facilitated expedited identification and recall of particular participant cohorts during the analysis, hence enhancing the efficiency and depth of the process. Moreover, it provided an easy reference system. For instance, when cross-referencing responses from EM authorities (A) with those from sectors (S), the alphabetical coding made the process more straightforward and less prone to error.

Following the recommendations of Miles and Huberman, the utilisation of these particular codes facilitated a strong connection between the researcher and the data, hence enhancing comprehension of each participant's viewpoint.

The interview data were analysed using a meticulously designed coding system, ensuring a high level of organisation and accuracy. The utilisation of alphabetical and numerical coding not only simplified the procedure of classifying and examining the data but also significantly contributed to preserving the qualitative thoroughness and reliability of the research. This technique emphasises the dedication to a thorough and careful examination, which is essential in deriving significant findings from the extensive data obtained from the diverse range of participants. Assigning alphanumeric codes to individuals made it more convenient to spot patterns, themes, or contrasting perspectives within this group. This method was especially advantageous for comparing replies among distinct coded groups, such as EM authorities against sectors or Risk Owner Organisations. When documenting the results, these codes provide a transparent and methodical approach to citing particular responses, safeguarding the confidentiality of the participants while enabling accurate referencing of their perspectives. In Figure 6, a detailed representation of the data-gathering procedure utilised in this study can be observed.



Figure 6: Data Collection Process (Author 2022)

4.5 Data Analysis

In addition to the examination of existing literature, this study employed two primary methodologies. As previously discussed, these were semi-structured interviews and document analysis. Overall, 48 senior emergency management officials from various government levels were interviewed to collect a wide range of perspectives and experiences. In addition, a thorough examination of several documents was carried out, including national emergency management plans, sector operational plans, governorate emergency management plans, the incident management system handbook, and emergency operation centre guidelines. This simultaneous strategy guaranteed a diverse and comprehensive collection of data.

In particular, the semi-structured interviews were specifically crafted to capture the varied viewpoints of senior officials, with questions customised to delve into the complexities of emergency management networks. The document study entailed a methodical examination of essential emergency management documents, offering a broad perspective of the operational and strategic frameworks now implemented.

Data analysis is a significant stage in a research study because is the process of examining and evaluating data in order to extract relevant information, find patterns, recognize trends, and make decisions. It is an important phase in research since it helps to detect trends or patterns, forecast results, and influence strategies and policies. Moreover, document analysis is a procedure that generally follows the sequence of searching for data, selecting relevant data, evaluating the data, and synthesising the data to construct new knowledge. Using qualitative methods such as content analysis, the researcher can organise data extracted into categories, themes, and case examples. The process combines content analysis and thematic analysis in an iterative process that seeks to answer the research questions. Thus, the two strategies for analysing documents described by O’Leary (2014), the interview and the noting techniques, were adopted in this study. In the interview technique, the document is treated as an informant or a respondent who answers the researcher’s questions.

The researcher then follows the steps described in the previous sub-section to analyse semi-structured interviews. In the noting technique, the researcher searches for keywords, phrases, and concepts to organise them via content analysis. Although a document may be rich in data, researchers should analyse each document critically. It must not be assumed that data or information in the documents are accurate, precise, and represent a comprehensive description of issues or events (Bowen 2009; O’Leary 2014). Hence, the researcher in this study established credibility, relevance, and sufficiency before exploring the meanings and perspectives presented in the findings.

The findings in this research conducted on the Oman Disaster Management System (ODMS) are based on an intensive and comprehensive collation and subsequent analysis of data retrieved from the sources described above. Consequently, data obtained from the interviews, document reviews, and case studies were collated, analysed, and used to obtain insight into a range of issues related to the research questions. Therefore, the results from this study were not pre-determined, instead are the outcome of the findings on the inter-sectoral coordination technique applied in Oman’s post-2010 emergency management system. Thus, using social

networks as the theoretical framework to analyse and explain three concepts: network governance, network characteristics, and network collaboration functions. Creswell (2014) notes that interpretive research employs methods of data analysis that are dynamic, iterative, and recursive. The data analysis in this study was fashioned along the lines of Creswell's observation.

Therefore, multiple data analysis methods, including content analysis and thematic analysis, are used to generate theories that seek to explain the contexts, nuances, and other pertinent characteristics of the phenomena under study. It leads to a taxonomy that can then be integrated into the final report. The taxonomy describes and interprets the whole phenomenon based on data gathered during the interviews.

In proving the reliability and effectiveness of the method used to ensure a thorough research study, content analysis, and thematic analysis used on two case studies were identified to justify this study's aim. Furthermore, the goal was to investigate the inter-sectoral coordination's similarities, differences, and nuances within the post-2010 Omani disaster management system, with an operational focus on the 2018 Mekuno and Luban Cyclones. The two case studies are: How did Oman DMS respond to and handle the 2018 Mekuno and Luban Cyclones? However, the use of thematic analysis in data analysis as replicated in this research is further expatiated in the next section.

4.5.1 Thematic Analysis of Data

This study adopted the thematic analysis procedure described in Braun and Clarke (2006). Thematic analysis is one of the effective ways to find, examine, and communicate patterns or themes in a dataset, especially when it requires finding repeating ideas, and concepts, and it entails methodically arranging and analysing textual or visual material.

The thematic analysis conducted in this study provides a structured yet flexible way to explore, identify, and analyse intersectoral coordinating themes in Oman's disaster management systems and SNT. In the context of the Omani DMS, thematic analysis was used to analyse interview transcripts, documents, and other qualitative data collected. This aligns with SNT by concentrating on network structure, interactions, and communication. This integration enhances the theoretical grounding of this research and provides a comprehensive understanding of coordination within the social network context.

Thematic analysis provides context-specific insights for Oman including insight into cultural, organisational, and environmental elements that affect intersectoral collaboration in the context of Omani disaster management. A thematic analysis approach allows the identification and exploration of key themes relevant to intersectoral coordination. This structured technique organises and understands data patterns and extracts significant coordination effectiveness themes. This provides a structured framework for examining qualitative data collected for this research. For thorough and coordinated analysis of varied datasets from various stakeholders in Oman's disaster management system ensuring a rigorous and organised analysis process. Thematic analysis adds transparency and trust to this research by recording and documenting analytical stages, interpretations, and results.

However, there are two effective approaches to thematic analysis, namely inductive and deductive. In an inductive approach, the data determines the themes. In a deductive approach, themes are preconceived based on existing knowledge and theory (Braun and Clarke 2006). In practice, research studies use both inductive and deductive analysis in the evaluation of projects. For instance, in a semi-structured interview, researchers are encouraged to have their interviews audio-recorded verbatim, regardless of any instance of poor communication by participants or inconsistencies in the flow of the discussion (Sutton and Austin 2015). This research study followed the process of conducting a thematic analysis of data which typically involves certain procedures and steps:

Familiarization with data: The first step in this process starts with the familiarization with data collected to gain a thorough understanding of its content. This involves listening to the audio and reading the documents or reviewing the data repeatedly to become familiar with its nuances and overall context before transcribing interview data from audiotapes to texts.

Generating Initial Codes: The second phase involves the generation of initial codes, which involves the systematic labelling and organisation of qualitative data to distinguish various themes and patterns. In relation to this, Saldana (2015) proposes the use of initial coding which entails thoroughly examining the data collected, such as interview transcripts and documents, and assigning codes to certain segments of text that succinctly capture their main content. Codes are simply tags or labels that provide a concise phrase or word to certain segments of data that are pertinent to the research inquiries.

Silver and Lewins (2014) described coding as the organisation of details of the phenomenon into a coherent picture or set of connected ideas in distinctive meaningful units. Coding leads

to the generation of categories used as units of analysis (Sutton and Austin 2015). An open coding procedure was used in this study to identify any common categories and patterns between the interview data and the literature review. It enabled the generation of the first set of themes and sub-themes as it concerns Oman Disaster Management System (ODMS).

In this research, coding involved systematically working through each interview transcript and document, making a note (code) every time the researcher came across a passage that provided insight into the research question. For instance, while analysing interviews of emergency management officials, codes were provided to segments of text that refer to “communication challenges”, “inter-agency collaboration”, “accountability mechanisms”, “standardization”, and “information sharing” among other codes. The next step involved looking for patterns in these codes across the different data sources.

Searching for Themes: The third step entails a comprehensive examination and assessment of the transcribed data and other analytical materials to identify significant themes and sub-themes that are pertinent to addressing the research questions and objectives related to ODMS. This stage is crucial in the process of inductive theme analysis since it goes beyond surface-level codes to interpret deeper patterns and meanings in the data, as explained by Braun and Clarke (2006). This stage included scrutinising the codes and identifying predominant patterns that could form themes. Themes refer to groups of related codes that effectively capture significant aspects of the data in connection to the research questions. For this research, themes identified included “EM structure”, “Governance Practices”, “Policies and strategies”, “Accountability Systems”, “Coordination Mechanisms”, etc.

The first set of themes and sub-themes were reviewed, and some of the sub-themes were combined to eliminate duplications.

The edited transcripts are then sent back to the participants for verification. It is also the practice that any ambiguity relating to issues discussed during the interviews is tagged and brought to the participants’ attention of the participants for clarification (Sutton and Austin 2015). Moreover, at this stage, details of the participants’ perceptions, interpretations, and meanings of their experiences are made known to the researcher. It offers the researcher a chance to acquire new ideas that could be explored in subsequent interviews and discussions.

Defining and Naming Themes: After establishing a selection of potential themes and assigning them a name that accurately represents their content and importance, the subsequent task required the further development of each theme and identifying the precise component of

the data that each theme represents. This process involves transforming the overarching topics of interest into a comprehensive and analytical storyline.

This involves reviewing themes to ensure proper identification has been done to reflect accurately that information obtained from the interviews conducted across various sectors involved in disaster management in Oman is consistent and meaningful. Also, the coded data is reviewed and compared to identify patterns and connections between different codes since themes are identified based on similarities,

The Writing up: The final stage undertaken in the thematic examination of the research data involves the composition of a comprehensive depiction that elucidates the connection between the themes and the wider scope of this research, particularly with regard to their correlation with SNT. Thus, providing a coherent and comprehensive account of the various themes by synthesising findings derived data to construct new knowledge relevant to explain the research objectives concerning ODMS.

The rationale behind the whole process is to get factual information from the study's findings due to the participants' lived experiences by using their narratives (Silver and Lewins 2014; Sutton and Austin 2015). In addition, a thematic procedure was used to validate the findings from the documents analysed and interviews conducted through techniques such as cross-checking for verification, and triangulation which involves comparing themes across different datasets or researchers.

In all, thematic analysis is a flexible and widely used qualitative research method that allows researchers to gain rich insights into participants' perspectives, experiences, and opinions. It offers a methodological framework for the analysis of qualitative data and aids in producing insightful and pertinent interpretations of the data.

4.5.2. Validity and Reliability

However, validity and reliability are concepts that are deeply rooted in quantitative research with their positivist stance. The positivist stance implies that the concepts of validity and reliability need to be redefined in the naturalistic settings of qualitative research studies. So, the consensus among qualitative researchers is that the concept of validity in qualitative research should focus on the "appropriateness" of the processes, instruments, and data retrieved in the study (Clark and Creswell 2010; Creswell 2014). The validity of this study is based on the appropriateness of the choice of methodology, design of methods, sampling, and data

analysis. On the question of reliability, qualitative researchers have also noted that the replicability of the processes and the similarity of results obtained each time are important. Cao and McHugh (2005) contend that a small margin of variability in findings can be tolerated. The methodology for this study has relied on past research demonstrating the effectiveness of qualitative research methods in obtaining valuable data (Clark and Creswell 2010; Creswell 2014).

There is proven evidence that the interpretive approach, document reviews, semi-structured interviews, and case studies are valid and reliable in qualitative research (Clark and Creswell 2010; Creswell 2014; Adams 2015; Gentles et al. 2015). Therefore, every effort has been made to ensure the validity and reliability of the findings obtained in this study.

4.5.3. Ethics, Health, and Safety

This research recognises that the participants are humans, both as individuals and as collective entities in their institutions. The study is concerned with status, behaviour, and relationships within and across organisations. Accordingly, the primary ethical issue is the respect and dignity of all participants in the study. The researcher paid due respect to the privacy and autonomy of all individuals and institutions. The personal integrity of all individuals in the study was protected and confidentiality was maintained. The choice of questions was sensitive to the power structure in the society under study as well as to the promotion of human dignity. In adherence to research ethics, approval for this thesis was obtained from Bournemouth University, including relevant agencies and institutions in Oman. Also, all participants were fully informed about the purpose of the study, and prior verbal and written consent was obtained from each participant.

Thus, the participants want the interview to be discreet without revealing their roles or job titles as the condition to participate in the research study. Therefore, any information they have shared is their views and opinions, not on behalf of their organisations, governments, or agencies (see Appendix 1, for Participant Agreement Form). Direct quotes are included from interviews as, according to Capps and Hazen (2002) direct quotes from interviewees are an essential component of thematic analysis. Transcripts of interviews and other evidential output from all the methods employed in this study have been attached in (Appendix 3 & 4).

The study results will be used solely and purposely to actualize the aim and objectives of the research information given to participants. At the same time, to avoid the risk of illegal or

inappropriate disclosures, only documents available to the general public or documents made available and approved for the study by participating individuals or organisations will be examined. In addition, approval for undertaking the study was obtained from the central government.

4.6. Conclusion

Overall, the methodological approaches to this study are essential to accomplish the aim and objectives of this research study, which is to ascertain the effectiveness and workability of the post-2010 Omani disaster management system reforms. The research method focuses on inter-sectoral coordination in a newly set-up Omani disaster management system. However, the need to develop a more practical approach that aligns with formal rules and informal measures is exigent while establishing an effective strategic partnership with cooperating local and international organisations. This study adopts the qualitative interpretive approach and uses standard tools and analysis to arrive at its findings. The study involved primary research explicitly designed to understand the context of the post-2010 Omani disaster management system.

The document analysis format and sampling technique developed and presented in this chapter were used to obtain data to verify the current structure of NDMS at three levels, national, governorate, and Wilayat levels. Therefore, the underlying factor is that the methods applied in this study were designed to derive useful information from the experience and expertise of top government and private sector officials involved in strategic planning and implementation.

Chapter 5 Findings and Discussion 1

5.1 Overview of the Omani Emergency Management System

The findings of this thesis are derived from the research conducted on the Oman Disaster Management System (ODMS). Thus, using social networks as the theoretical framework made the research study feasible and enabled the research to focus on three concepts: network governance, network characteristics, and network coordination functions. The next three chapters primarily analysed and discussed the interviews' findings and supported by findings in the document reviewed. The semi-structured interviews were with 48 participants representing senior officials and decision-makers who have had direct experience working on the emergency management system at different government levels, including the National Committee for Emergency Management (NCEM), Sectors, Governorates Emergency Management Committees (GEMCs), and Wilayat Social Development Committees (WSDCs). Interviewees anonymously shared their knowledge and views on questions related to the Omani EMS. The interview questions focus on the Omani emergency management structure in general, the governance system of the Omani emergency management system in response and risk reduction phases, and intersectoral coordination functions practised with the Omani EMS.

5.2 NDMS Response to Oman's Vulnerability to Disasters

The findings from this chapter revealed Oman's Post 2010 disaster management system, its structure, and Omani approach to emergency management as revealed by the interviewees and after a comprehensive analysis of essential documents including the Omani Civil Defence Law (Royal Decree 76/91 amended by RD 75/99, and RD 3/2020), the National Emergency Management Plan, as well as other emergency management documents and reports issued by the Omani emergency management authorities.

Both interviews and document analysis indicate that Oman's proximity to the Indian Ocean and the Arabian Sea makes it extremely prone to natural hazards such as tropical cyclones, torrential rains and floods, and regional Tsunamis. The country is also in an area that experiences active seismic movements, making it vulnerable to earthquakes. In addition, Oman is vulnerable to biological and public health hazards, including epidemics, pandemics, and sporadic fire outbreaks in industrial plants (A1, S1, S2, S3,2022). The document analysis further shows that Oman is vulnerable to human-induced hazards such as chemical spills, oil pollution, radiation, and nuclear hazards (NEMP 2018).

The research findings indicate that the emergency management model adopted in Oman has been developed from the broad principles of emergency management proposed by the United Nations International Strategy for Disaster Reduction (UNDRR) (A1, 2022). Furthermore, the findings showed that Oman is among many countries implementing the UNDRR comprehensive disaster management approach. Consequently, the view in the contemporary Omani model is that of an ‘all hazards and all stakeholders approach’ in four distinct stages of a disaster, namely mitigation, preparedness, response, and recovery.

In addition, findings from interviewees across various sectors confirmed that Oman’s plans for disaster management are based on the understanding that:

“Hazards are interconnected. A disaster could start with a cyclone, which leads to floods, which could cause disruption in critical infrastructure services and/or industrial accidents, which in turn will cause chaos, and probably civil unrest” (S24, 2022).

However, all interviewees in this study were asked a specific question. What are the most likely hazards confronting Oman today? The consensus response from all participants (n=48) was the same, that cyclones and related hydrological hazards such as tsunamis and floods pose the most significant threats. However, industrial accidents that might cause chemical spills or radiological incidents also top the list. Other hazards mentioned include epidemics, earthquakes, and nuclear incidents. As a result, many varieties of hazards pose threats to Oman.

Research data obtained from most of the interviewees confirmed that the vast number of hazards might explain why Oman has chosen a specific structure in its post-2010 National Disaster Management System (NDMS), to adopt the contemporary methodology recommended by UNDRR. Moreover, the shortcomings of the Omani emergency system in managing the devastating effects of cyclone Gonu in 2007, and cyclone Phet in 2010 prompted the need to develop a proactive function-based system, to effectively respond to disasters (A1, S30, S4, 2022).

5.3 The Omani Emergency Management Approach

Further investigation in this research thesis shows that the Omani government, in 2010, through its agency, the National Committee for Emergency Management (NCEM), approved the National Emergency Management Plan (NEMP), which was designed to implement the Civil Defence Law (Royal Decree 76/91 amended by RD 75/99). However, the NEMP was only activated when the NCEM Chairman, the Inspector General for Police & Customs declared a

national disaster. Although, the disaster declaration may include only specific parts of the country or encompass the entire country, depending upon the extent of the disaster.

The finding from this research echoes the assertion that the pre-2010 former hierarchical organisational response system did not work for NCEM in those two disasters based on the evidence uncovered. As a result, in 2010, there was a reformation in the National Emergency Management Plan (NEMP). The establishment of NEMP was published in February 2011 and took effect as an operational guide of national response tasks in November 2011 to coordinate response operations during Cyclone Keila which hit the southern coastal areas of the country (A1, 2022).

Still, research findings from this thesis further disclosed the legal process surrounding the signing of NEMP into law on January 18, 2018. (IGPC Order #28/2018), as well as requires the NEMP to “integrate national and governorate mitigation, preparedness, response, and recovery plans into one all-discipline, all-hazards plan.” Also, information retrieved from documents reviewed showed that the NEMP incorporates and replaces previous plans concerning emergency management structures. The NEMP outlined eight sectors and, at the same time, established both lead and support agencies for each of the eight sectors. The NEMP underlined the command, the control structure, and identified the functional responsibilities of each organisation in providing response and assistance to affected localities. The NEMP establishes the policies and concepts of operations or the emergency management doctrine for the emergency management system in Oman (A1, A2, S4, 2022).

Findings from the interviews with the forty-eight participants confirmed that the NEMP is the primary reference document for all actors within the Omani DM system. The fact that there are numerous and diverse actors in the system implies the need for an effective communication system within the structure of NDMS. Directive number 28/2018 issued by the chairman of the National Committee for Emergency Management (NCEM) communicates the existence of NEMP, SOPs, and formal communication/coordination mechanisms.

Empirical data from the research study revealed that the overall outlook of disaster management in Oman is seen as a complex activity involving interactions and relationships of individuals and peer organisations across sectors, hence the need for less centralised leadership (A1, A2, S1, S6, S9, S14, 2022). Thus, some of the participants interviewed underpinned that the traditional disaster management system prior to 2010 in Oman was more of a centralised traditional management style. Also, all the interviewees acknowledged that the current

approach involves a shift in paradigm in favour of relocating resources and capabilities nearer to vulnerable communities. The participants viewed the shift in paradigm as a welcome development.

Additionally, the research showed that the disaster management strategy in ODMS is founded on five principles (A1, A2, 2022):

- National and local priority for a risk reduction system that uses a strong institutional platform for implementation.
- Emphasis on identifying, assessing, and monitoring disaster risks and risk analysis should form the base for any emergency management process.
- Improving early warning and public awareness.
- Improving response capabilities.
- The use of knowledge, innovation, and education to build a culture of safety and resilience at all levels.

However, the documents analysed confirmed that the NEMP sets out much of the strategic plan and adopts a comprehensive disaster risk management approach. The ultimate goal of the NEMP is that of national resilience. According to a senior official from the emergency management authority:

“Disaster Risk reduction is an integral component in the national disaster management system. Disaster risk reduction principles are well defined in the NEMP. Risk reduction's roles and responsibilities are clearly defined for each participating organisation within the NDMS. National resilience is achieved through enhancing community and business resilience, respectively, and this requires a solid partnership with all stakeholders. Effective response and recovery are achieved through the adoption of a common (unified), well-integrated and coordinated system, which efficiently utilizes enhanced resources and capabilities.” (A3, 2022)

It was discovered from the information collected from about 37.5% (n=18) of participants interviewed across the various agencies that one of the main goals of the Omani emergency management system is to achieve a high degree of resilience to emergencies and disasters. Accordingly, the National Committee for Emergency Management (NCEM) approaches this goal with a strategic plan derived from the NEMP that considers resilience to have two components: community resilience and organisational/business resilience.

Likewise, the interview with a senior official from the NCEM posited that national resilience is best achieved via enhancing community and business resilience, respectively, and this requires a solid partnership with all stakeholders (A1, 2022). Other interviewees concurred with this view, noting that the approach fosters resilience of the public and private sectors through risk reduction and hazard mitigation measures, as well as the development and sustenance of emergency plans and business continuity plans (A4, S1, S6, S7, S18, S30, 2022). They further stated that the method adopted for enhancing national resilience is based on multi-sectoral coordination that enjoins public agencies, the private sector, NGOs, and international organisations in a common cause. In addition, there was a consensus among interviewees that knowledge, innovation, and education are the key tools for building a culture of safety and resilience at all levels in Oman.

5.4 Oman Emergency Management Structure

The interviews conducted among officials from the emergency management system showed that the National Disaster Management System NDMS in Oman is a hierarchical system with a chain of command under the National Security Council (A3, 2022). The NCEM maintains a strict three-level command and control system at the national, governorate, and Wilayat levels (A1, 2022). Meanwhile, the National Emergency Management Plan lists the National Committee for Emergency Management (NCEM), the National Emergency Management Centre (NEMC), the Governorate Emergency Management Committees (GEMCs), and the Sectors which comprise lead organisations and other supportive agencies as the key constituent parts of NDMS are enumerated in Figure 7.

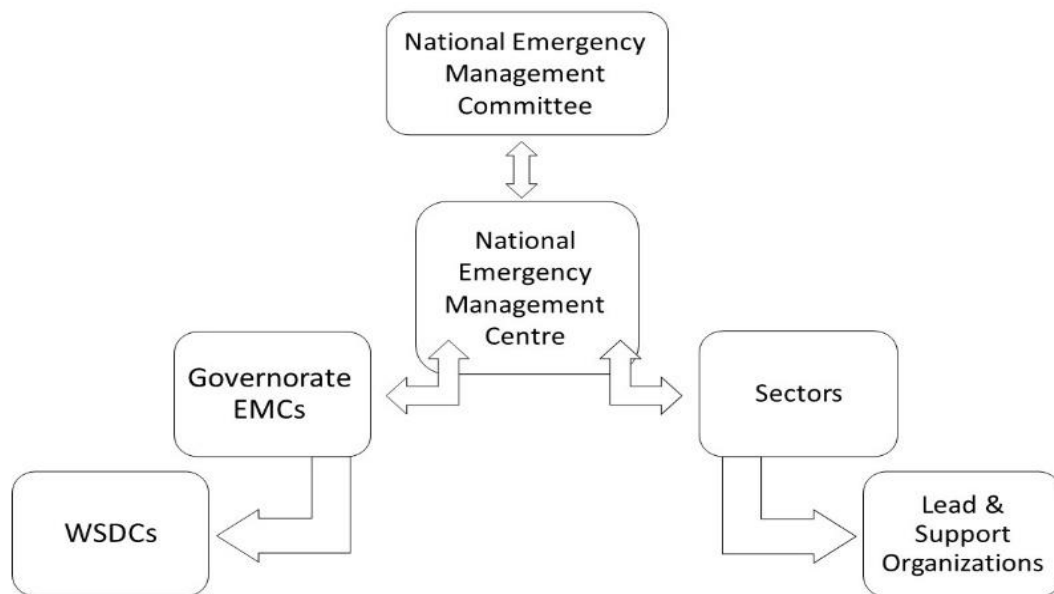


Figure 7: NDMS Structure and Inter-Relationships of Committees and Sectors (NEMP 2018)

5.4.1 National Committee for Emergency Management (NCEM)

Interviews and document analysis showed that the National Committee for Emergency Management (NCEM) is the official umbrella body for emergency management in Oman. It was established in 1988 and is chaired by the Inspector General for Police and Customs (the equivalent of the Minister of Interior in most countries). The Committee members comprised senior officials (Undersecretaries) from various ministries, agencies, armed forces, police, NGOs, and the private sector (A4, 2022). The NCEM is primarily attached to the Royal Omani Police, and as a result, its leadership style is like that of military institutions (A1, 2022).

The NEMC is designated in two Royal Decrees ((Royal Decree 76/91 amended by RD 75/99, and RD 3/2020) as the lead agency in the EM system. The decrees give legal backing to the Civil Defence Law and the State of Emergency Law that regulate emergency management in Oman. The two laws, when read together, clearly spell out the role of NCEM as that of providing leadership in national emergency management. NCEM is mandated to develop significant governmental policies, plans, and protocols, and oversee national governmental subcommittees (A2, 2022). For instance, according to Article (22) of Chapter Six of the Civil

Defence Law, the NCEM is mandated with “developing an integrated Disaster Management Plan and defining the duties and responsibilities of ministries and various government entities in charge of implementing it, setting up Emergency Management Committees in Governorates, and defining their areas of intervention and setting organisational rules for their framework” (Civil Defence Law 91).

According to the National Emergency Management Plan (NEMP), The National Committee for Emergency Management (NCEM) is responsible for activating, leading, and implementing the National Emergency Management Plan, taking public evacuation decisions, coordinating national efforts to manage major emergencies and critical incidents (mitigation, preparation, response, and recovery); and enhancing national capabilities and resources (National EM Plan, 2018).

The information data contained in Table 9 shows the latest NCEM structure (A1,2022). NCEM is chaired by the Inspector General of Police and Customs, other members represent various public institutions, the military, and Humanitarian organisations. Table 9 shows NCEM membership based on each sector.

Table 9: Description of NCEM Membership Based on Sectors (NEMP 2018)

Sector	Number of organisations	Details
Military & Police	3	Armed Forces, ROP, Civil Defence
Ministries & public departments	22	Representing line ministries and
NGOs	1	Oman Charitable Organisation (Oman does not have a Red Cross Red Crescent society)
Total Members	26	

All interviewees (n=48) in the semi-structured interviews agreed that NCEM is the most powerful organisation in the system. The consensus agreement among the interviewees showed that the NCEM is in firm control and exercises its authority diligently and judiciously over an EMS that comprises eight sectors, eleven Governorate Emergency Management Committees (GEMCs), and sixty-one Wilayat Social Development Committees (WSCS).

5.4.2 The National Emergency Management Centre (NEMC)

The National Emergency Management Centre (NEMC) operates at the national level as the heart of the disaster management system in Oman. It is responsible for coordinating, monitoring, and planning preparedness activities carried out by EM sectors (A1, A4, A5, A6, 2022).

5.4.3. Governorates Emergency Management Committees

At the Governorate level, Governorate Committees for Emergency Management (GCEMs) are charged with disaster and emergency preparedness within their geographical jurisdictions (A2, A4, A5, A6, 2022). Interviews and document analysis indicate that GEMCs are mandated to take appropriate disaster management decisions including approving response plans, ensuring the implementation of standards, assessing policies issued by the NCEM, and implementing capacity-building programs (A1, A4, A5, A6, 2022). Furthermore, the GEMCs activate and coordinate resources and information-sharing efforts within the governorates.

GEMCs are chaired by the Governorate Police Chief, with members representing sectors and lead and support agencies. All the five Chairmen of GEMCs interviewed acknowledged that the role of the GEMC is to ensure that the governorate is ready to deal with any disaster or major incident. In addition, the GEMC is responsible for enhancing governorate resilience by developing and implementing the Governorate Emergency Management Plan (GEMP) (A1, A2, A4, A5, A6, 2022).

The Chairman of one of the GEMCs stated:

“My main duty is to ensure that the Governorate Emergency Management System (GEMC) is ready to respond to any disasters or major emergencies. At the same time, I oversee governorate preparedness, command and coordinate response efforts carried out by various sector/s member agencies, in order to minimise impact and recovery efforts through cooperation, resource sharing, and facilitation of support among various government organisations, non-government organisations, and the private sector.” (A4, 2022)

5.4.4 Wilayats (Local) Emergency Management Committees

Both Interviews and document analysis indicate that while there should be emergency management committees at the local level as per the NEMP, this is yet to be practised. It is

established from the findings that although the NCEM has branches in each governorate (GEMCs), it does not have branches at the local (Wilayat) level (S34, 2022). Information obtained from 80% of interviewees (n=38) indicate that as an interim solution, the NCEM delegated some function of emergency management to Wilayat Social Development Committees (WSDC). An official from one of the WSDCs interviewed asserted that the Walis (Mayer) chair of the Wilayat Social Development Committee (WSDC) (S34, 2022). Documents analysis shows that the WSDCs were created in 2016 according to Ministerial Decision No. 140/2016 (S17,2022) as extensions of the Governorate Relief and Shelter Sector, operating at the Wilayat level” (S34, 2022). The WSDCs comprise members representing various local government departments, community representatives, representatives of the Omani Women Association, and the Oman Charitable Organisation.

WSDCs' roles and responsibilities are assigned during the response phase under national and governorate EM plans, which include the following (humanitarian) scope:

1. Community awareness by alerting the public and making residents aware of risks that might happen/be about to happen, i.e. cyclones.
2. Ensure we have proper shelter/food for affected communities within the Wilayat.
3. Distribution of relief items to affected communities.
4. Coordinate the donations and volunteer activities at the community level.

5.5 Sectors

The significance of this empirical work is the findings that demonstrate the inner process and coordination in the Oman Emergency Management System. Thus, a vital revelation in the NEMP set-up is the value attached to sectors, which are considered emergency support function clusters. The main findings from each of the Sectors made up of governmental, NGOs, and specific private sectors with the capabilities of an organisational structure would be outlined. Furthermore, sectors provide support, resources, program implementation, and services that are most likely needed to save lives, protect property, and the environment, and restore essential services and critical infrastructure, including helping victims and communities return to normal activities following a major emergency (NEMP 2018). Sector resources can only be activated through an operational directive issued by the NCEM Chairman (A1, 2022).

The findings from a series of interviews conducted during the research showed that sectors provide the structure for coordinating national inter-agency support for a national-governorate

response to a most critical emergency (S3, 2022). Also, data analysed revealed that it is a way to enable the group to function effectively and respond to governorates (A4, 2022). It allowed the National Emergency Management Plan to organise the government's essential emergency operations into eight emergency support functions for easy coordination, which are as follows:

- Emergency Support Function # (1): Early Warning & Risk Reduction Sector
- Emergency Support Function # (2): Media & Public Awareness Sector
- Emergency Support Function # (3): Search & Rescue Sector
- Emergency Support Function # (4): Medical Response & Public Health Sector
- Emergency Support Function # (5): Relief & Shelter Sector
- Emergency Support Function # (6): Victims Affairs Sector
- Emergency Support Function # (7): HAZMAT Sector
- Emergency Support Function # (8): Critical Infrastructure Sector (NEMP, 2018)

All interviewees (n=48) confirmed the existence of the 8 sectors. The sectors allow actors within NDMS to have frequent interactions in the course of their duties (A2, S1, S5, S9, S16, 2022)

Further findings from all the participants in the interviews submitted in the NEMP operational guide indicate that the general roles and responsibilities of 8 sectors are divided into four categories: risk reduction, preparedness, response, and recovery (NEMP 2018). According to the NEMP, risk reduction is an integral part of emergency management in Oman. In the risk reduction phase, sectors (along with other organisations) are tasked with assessing potential risks and implementing needed risk reduction measures (NEMP 2018). Then, the preparedness phase involves developing a response plan, guidelines, and mobilizations to ensure operational readiness. In, the response phase, sectors are mandated to promptly react to emergencies to minimize the destruction and casualties. Lastly, the recovery phase ensures victims of disaster are adequately cared for and rehabilitated back into society, as well as rebuilding destroyed infrastructures.

Besides, all the 48 participants in this study agreed that aside from the four prominent general roles mentioned above, each of the eight sectors performs different additional roles depending on its area of expertise. Therefore, the 48 interviewees comprising representatives from each sector, the Governorates, and the Wilayats, confirm their roles in disaster management, which gives credence to the finding. The other findings are as follows.

5.5.1 Early Warning Sector (EWS)

The main findings after a detailed analysis of documents and interviews of officials about the Early Warning Sector (EWS) as a critical sector in the NEMC show that the sector is empowered to provide early warning functions regarding hazards, including forecasts, warnings, and public awareness activities. Also, update and share vital information with relevant agencies, as well as Participate in disaster response planning efforts at the NEMC (S1, 2022). Besides, the EW Sector only functions at the national level and is mandated with coordinating risk reduction efforts (S1, 2022).

Moreover, the information provided by all interviewees (n=48) reveals that the Early Warning Sector is solely under the Civil Aviation Authority (CAA). It owns and controls the National Multi-Hazard Early Warning Centre. The CAA is responsible for and supervises the Early Warning sector's activities (A1, S1, 2022). EW is Chaired by the Chair of the CAA and coordinated by the Director General of Metrology (S1, 2022).

Further empirical evidence showed that the main strength of the Early Warning Sector is that it is critical for effective response to emergencies and collaboration with other agencies in other sectors. This is carried out through the Civil Aviation Authority, which coordinates the entire early warning systems and risk reduction efforts for national-level emergencies. In collaboration with other risk owners' organisations, including the Directorate General of Water Resources (hydrological risks), Earthquake Monitoring Centre, Department of Communicable Diseases, Environment Authority, Department of Fire and HAZMAT Prevention, Department of Bio-hazards (S2, 2022).

5.5.2 Media and Public Awareness Sector (MPAS)

The main finding regarding the Media and Public Awareness Sector (MPAS) in this research discovered in the series of interviews with the participants shows that the sector performs two essential functions, provide emergency management-related information to the public and coordinate risk reduction awareness activities and programs in Oman. The finding from 85% of the interviewees (n=40) indicates that MPAS is mandated to activate the public information plan and the Joint Media Centre. So that information officers from all response organisations represented can act accordingly and ensure media coverage of emergency situations to enable the public aware of an outbreak of disasters (S3, 2022). Interviews pointed out other roles of MPAS in Risk Reduction, which indicates that the sector is mandated with developing public

awareness programs for potential risks. MPAS should achieve that by working in coordination with EWS along with the education system and local governments (A1, S3, 2022). The Media and Public Awareness Sector is chaired by the Ministry of Information (MOF) and is coordinated by the Director of Oman News Agency (A1, S3, 2022).

5.5.3 Medical Response and Public Health Sector (MR & PH)

The Medical Response and Public Health (MR & PH) sector is very critical in providing first aid and medical services to disaster victims. 95% interviewed (n=45) posited that the services of responding agencies in the MR & PH sector are often the most needed in an emergency. A senior official from the MR & PH interviewed outlined the role of the sector as:

"Providing medical treatment to the injured, ensuring medical services are provided to the affected population (the non-injured), and that medical facilities are working as usual (business continuity of hospitals and other medical facilities), monitoring and responding to any public health risks" (S14, 2022).

Furthermore, the sector also coordinates resources to support the healthcare system surge. Maintain health and medical inventory and provide a mechanism to receive, stage, store, and distribute any additional items received during an incident. (S10, 2022).

As revealed by the participants, the Ministry of Health (MOH) is the primary agency responsible for the Medical Response and Public Health Sector (A1, S10, 2022). MR & PH Sector is Chaired by the Undersecretary of the Ministry of Health and coordinated by the Director of MOH's Emergency Operations Department (S1, S11, S12, 2022). The MR&PH Sector includes representatives from fifteen diverse organisations, including the Armed Forces Medical Services, Police Medical Services, private sector hospitals, and international organisations such as the World Health Organisation. (S13, 2022).

5.5.4 Relief and Shelter Sector (R&SS)

Interviews indicate that the Relief and shelter sector is another critical aspect of the Oman National Emergency Management Plan. the R&S Sector is mandated to provide shelter and relief items to affected populations, ensure enough essential goods are in local markets, monitor goods prices, and prevent monopoly. (S15, S16, S17, 2022). According to interviews and document analysis, the R&S is the only sector at the local/ Wilayat level (S19, S34, S35, S37, 2022). AT the Wilayat level, R&S Sector operates via the Wilayat Social Development

Committee WSDCs). The R&S Sector is chaired by the Undersecretary of the Ministry of Social Development and coordinated by the Director of the Social Services Department (S15, 2022). The Ministry of Social Development leads and coordinates overall relief and shelter efforts during emergencies at the national-governorate-Wilayat level in collaboration with other public, NGOs, and private organisations (S18, 2022).

5.5.5 Search and Rescue Sector (S&R)

Findings concerning this sector show that the Search and rescue sector is primarily responsible for coordinating search for victims of disasters sequence rescue operations, and distribution of rescue resources among various agencies, including the armed forces, police, and volunteers. The sector's core role in the EMS is to answer rescue calls and requests, search for missing persons, and help evacuation efforts (A2, S5, S6, S7, S8, S9, 2022). The S&R sector is coordinated by the Authority for Civil Defence & Ambulance (ACDA).

5.5.6 Critical Infrastructure Sector (CIS)

Interviews and document analysis indicate The main role of the Critical Infrastructure Sector (CIS) is to ensure that all infrastructure services essential for the functioning of the economy and society are protected and restored to pre-disaster operational levels as soon as possible (S24, S25, S26, S27, S28, S29, 2022). The Authority for Public Services leads and coordinates overall risk reduction, business continuity, and restoration efforts of critical services (A1, S24, S25, 2022). According to a senior official in the sector, the CIS pays particular attention to assets that are associated with energy, telecommunications, water, transportation, and fuel:

“The CIS is mandated with activating CIS plan and CIS EOC, ensuring that information and warning are disseminated to all sector member organisations, direct member organisation/facilities to activate their emergency response and business continuity plans”. (S24, 2022).

Still, the CIS Sector mobilises technical teams, spare parts, and other resources to restore critical infrastructure services, including Roads, Electricity, Water, Communications, Sewage systems, and Fuel (S25, S27, 2022).

5.5.7 HAZMAT Sector

The main finding from the interviews conducted shows that the HAZMAT Sector is a highly specialised sector focused on providing an effective response in emergencies that involve hazardous substances; in particular, substances that may pose a reasonable threat to health, environment, and property. Examples are toxic chemicals, fuels, nuclear waste products, and biological, chemical, and radiological agents (S30, S31, S32, 2022). HAZMAT Sector is coordinated by the Authority of Civil Defence & Ambulance Authority (ACDA). The Civil Defence & Ambulance Authority leads and coordinates overall HAZMAT risk reduction and response efforts in collaboration with the Environment Authority, Armed Forces, and the private sector (A2, S30, 2022). A senior manager in the HAZMAT Sector explained that:

“The HAZMAT Sector’s role is to coordinate response to HAZMAT incidents and resource sharing among various agencies, including the armed forces, the police, the private sector, and international organisations.” (S31, 2022)

The senior manager sees the main duty of senior management in the HAZMAT Sector as follows:

“Coordinating and working toward achieving integration among the sector’s member agencies in order to be able to provide help to those who are in need of rescue through cooperation, resource sharing, and facilitation of support among such agencies.” (S31, 2022).

5.5.8 Victims Affairs Sector (VAS)

The leading finding from this sector echoes that the Victims Affairs Sector (VAS) operates only at the national level and is in charge of handling the deceased identifying their identity and handing over the remains to the families (S20, S21, A3, 2022). An additional finding from the interviewees (A1, S20, S 21, S22, 2022) reveals that the VA sector is also responsible for running the Victims Information Centre (VIC). Interviews and document analysis indicate that the Directorate of Forensic Labs/Royal Oman coordinates sector operations. Its role includes resource sharing among various mortuaries, and other forensic and medical agencies including the armed forces, the police, the University Hospital, the Ministry of Foreign Affairs, the private sector medical services, and International Governmental Organisations such as the Interpol (A1, S20, 2022).

Table 10: Summary of the Eight Sectors (NEMP 2018)

	Sector	Lead Organisation	Presence	Responsibilities
1	Early Warning	Civil Aviation Authority	National	Risk analysis, risk mitigation, hazard, public awareness, early warning systems.
2	Media and public Awareness	Ministry of Information	National	Management of public information and public outreach campaigns
3	Search & Rescue	Civil Defense and Ambulance Authority	National & Governorate	answer rescue calls and requests, search for missing persons, and lead in evacuation efforts
4	Medical response & Public Health	Ministry of Health	National & Governorate	Providing medical treatment, monitoring and responding to public health risks
5	Relief & Shelter	Ministry of Social Development	National, Governorate, & Wilayat	Providing shelter and relief items to affected populations
6	Critical Infrastructure Sector	Public Services Authority	National & Governorate	Continuity and restoration of public services (electricity, water, communications, roads, etc)
7	HAZMAT Sector	Civil Defense and Ambulance Authority	National & Governorate	Risk reduction and response to HAZMAT incidents
8	Victims Affairs (VA) Sector		National	dealing with deceased bodies, identification of the deceased, and handing over the remains to the families.

5.6 Analysis of the Omani Emergency Management Network

With the aim of identifying network features existing in the Omani emergency management system as prescribed in the National Emergency Management Plan (NEMP), the researcher used social network analysis tools (SNA) to identify various network attributes including network density, central organisations/sectors, and providing a visual representation of the

network. The researcher developed a network matrix as the basis for this network analysis. Based on the coordination organisations, sectors, and the primary supporting organisations identified in the NEMP, a matrix of the National Emergency Management Plan (NEMP) was developed with a symbol of a tie indicated with a ‘1’, and no tie is indicated with a ‘0’.

Table 11 below shows a matrix of network relationships among ODMS organisations as laid in the NEMP. The data has been entered into Network X, a network analysis software developed by Hagberg et al. (2011) to analyse complex networks. Network X is a comprehensive program for the analysis of social networks. The program contains several network analytic routines, such as centrality, density, centralization, clique, and more.

As explained in earlier chapters, NEMP uses the emergency support function or sector system in its comprehensive emergency management framework. Primary and secondary organisations are identified to carry out specific support functions in response to disasters. Moreover, Figures 8 and 9 show graphical representations of the Omani emergency management system according to the NEMP and visualize how primary and secondary organisations are clustered around certain support functions. The figure represents the planned interactions laid out in the NEMP. Nodes represent the organisations listed in the plan based on their planned activities by the sectors. The node size shows the number of connected edges to the particular node. The higher the number of edges, the bigger the size of the node, which means that bigger nodes are more influential in the operation.

Table 11: Matrix of Network Relationships (Hagbarg et al. 2018)

	NE MC	EW S	MP AS	S\& RS	MRP HS	R\& SS	VA S	CI S	HAZM AT	RO P	MOD ef
NEMC	0	1	1	1	1	1	1	1	1	0	0
EWS	1	0	1	0	0	0	0	0	1	0	0
MPAS	1	1	0	0	0	0	0	0	1	0	0
S\&RS	1	0	0	0	1	0	1	0	1	0	0
MRPHS	1	0	0	1	0	1	1	0	1	0	0
R\&SS	1	0	0	0	1	0	1	0	1	0	0
VAS	1	0	0	1	1	0	0	0	1	0	0
CIS	1	0	0	0	1	1	0	0	0	0	0
HAZMA T	1	0	0	1	1	0	1	0	0	0	0
ROP	1	0	0	1	1	1	1	0	1	0	0
MODef	1	0	0	1	1	1	1	1	1	0	0
MOInt	1	0	1	0	0	1	0	0	0	0	0
MOHlth	1	1	0	1	1	1	1	0	0	0	0
MOSD	1	0	0	0	0	1	0	0	0	0	0
MoInfo	1	0	1	0	0	0	0	0	0	0	0

CivDefA	1	1	0	1	1	0	1	0	1	0	0
A	1	1	0	0	0	0	0	0	0	0	0
CivilAA	1	0	0	0	0	1	0	1	1	0	0
MOCComI	1	1	0	0	0	0	0	0	0	0	0
nd	1	1	0	0	1	0	0	0	1	0	0
WatRsc	1	0	0	0	0	0	0	0	0	0	0
MOFihsA	1	0	0	0	0	0	1	0	0	0	0
g	1	0	0	0	0	0	0	0	0	0	0
MOFA	1	1	0	0	0	0	1	0	0	0	0
EnvA	1	0	0	0	1	0	0	0	1	0	0
MOEdu	1	0	1	0	0	1	0	0	0	0	0
MOHEdu	1	0	1	0	0	1	0	0	1	0	0
Municipal	1	0	0	1	1	0	1	1	1	0	0
Comm.Re	1	0	1	0	0	0	0	1	0	0	0
g.A	1	0	0	0	0	1	0	0	0	0	0
CultTrsm	1	0	0	0	0	1	0	0	0	0	0
CnsmrPA	1	0	0	0	0	1	0	0	0	0	0
MTT\&IT	1	0	0	1	0	0	1	1	1	0	0
SQU	1	1	1	0	1	1	1	0	1	0	0
SCP	1	0	0	0	0	0	0	0	0	0	0
Ocharity	1	0	0	0	0	1	0	0	0	0	0
Univ\&Co	0	0	1	0	1	1	0	0	0	0	0
lg	1	0	1	0	0	0	0	0	0	0	0
ONCSC	0	0	0	1	1	0	0	1	1	0	0
ENVCO	0	0	0	0	0	0	0	0	0	0	0
M	0	0	1	0	0	0	0	1	0	0	0
TELC	0	0	0	1	0	0	0	0	0	0	0
COM	0	0	0	1	0	0	0	0	0	0	0
OmaniAir	0	0	0	1	0	0	0	0	0	0	0
Ferry	0	0	0	1	0	0	0	0	0	0	0
Volunteer	0	0	0	1	1	1	0	1	1	0	0
NGOs	0	0	0	0	1	1	0	0	0	0	0
Private	0	0	1	1	1	1	1	1	1	0	0
Sector	1	0	0	1	1	1	1	0	1	0	0
IGOs	1	0	0	0	0	1	0	0	0	0	0
MOY\&S	1	0	0	0	0	1	0	0	0	0	0
rpt	1	0	1	0	0	1	1	0	0	0	0
MORilgA	1	1	0	0	1	0	0	1	0	0	0
WaterSE	1	0	0	0	0	0	0	0	0	0	0
WG	1	0	0	0	0	0	0	0	0	0	0
Utility Co	1	0	0	0	1	0	0	1	0	0	0
OilMinr	1	0	0	1	0	0	0	0	1	0	0
MOFin	1	0	0	0	0	0	0	0	0	0	0
CbankOm	1	0	0	0	0	0	0	0	0	0	0
Pproscu	1	0	0	0	0	0	0	0	0	0	0
Indus Zon	1	0	0	0	0	0	0	1	1	0	0
CIChamb	1	0	0	0	0	1	0	0	0	0	0
PServA	1	0	0	0	0	1	0	0	0	0	0
GEMCs	1	0	0	0	0	0	0	0	0	0	0
WSDCs	0	0	0	0	0	1	0	0	0	0	0

5.6.1 Density

The density of this network is equal to ~ 0.07 which means that the Omani EM System network as prescribed in the National Emergency Management Plan (NEMP) is relatively sparse. A low-density score typically suggests that there are relatively fewer actual connections among the organisations or nodes in the network compared to the total possible connections. This could mean that information does not transmit very efficiently across the low-density organisation because it has to go from member to member and finds it challenging to diffuse due to the process of information flow in the network. Another issue might be that if one or two members are taken out of the network, the network can suffer a breakdown. since they are no longer there to coordinate the different parts that do not talk to each other or the presence of structural holes or “the lack of a tie between two alters within an ego network” (Borgatti et al. 2013, p. 275). However, a low-density score could signify efficient resource allocation. For example, in the ONDMS network case, it may not be necessary for all organisations to have a direct connection with each other. Instead, organisations can focus on specialised roles and tasks, allowing them to allocate resources more effectively and avoid redundancy in their efforts (Abbasi et al. 2018). Moreover, a low-density score might align with a task-specific coordination strategy. That is, the Omani EMS seeks that various organisations within a sector come together for specific tasks or functions. These task-specific collaborations may not require extensive direct connections but can be coordinated through central hubs or coordination centres i.e., sector coordinators or the sector’s emergency operations centres (EOC). This corroborates with the aims and objectives identified in the NEMP (NEMP).

5.6.2 Centralization

Centralization indicates the degree to which a few members hold the greatest number of connections in the network or the extent to which a network is dominated by the connections of one or a few organisations or the power structure of the network_(Borgatti et al. 2013; Comfort and Kapucu 2006). The centralization of this network according to different centralities depends on different nodes. For instance, computing centralization with degree centrality returns 9.3%. Thus, it implies low cohesion and high variability in centrality scores. From the figure of this network graph above, if we particularly focus on the degree of centrality, we can see that the National Emergency Management Centre (NEMC) node has a bigger size than other nodes in the network, and most of the nodes in this network depend on that node particularly. This means that NEMC is the dominant lead or administrative organisation in the

network. This corroborates with roles and responsibilities assigned for the NEMC in the NEMP (NEMP).

On the other hand, a centralized system with a core organisation allows the central organisation to facilitate and coordinate the activities of member organisations in a service implementation network (Milward and Provan 1998). The nature of the command-and-control structure determines the emergency coordination network. The network structure is centralised around the coordinators of the response operation, such as the incident coordinators. These central coordinators have the power to control the circulation and flow of information in the network (Cardona 2004).

5.6.3 Centrality Measures

In emergency networks, the role of organisations can be understood through the use of centrality measures to understand which ones play brokerage and dissemination roles in the network (Moore and Daniel 2003). Centrality measures reveal how well connected any organisation is within a network based on the number of incoming and outgoing ties of a particular organisation. Thus, it can identify the key players and prominent actors in a network (Heinimann and Hatfield 2017).

The basic assumption of degree centrality is that the more connections an actor has, the more powerful and vital that actor will be to the network. An analysis of degree centrality shows that organisations should interact more with other organisations in the EMS network. The total degree centrality calculated by Network X shows that NEMC has the highest degree centrality and can be regarded as the most influential in the NDMS network. In emergency networks, it is expected that the coordinator agency is supposed to have more cooperation than any other actor within the network. Therefore, in the degree centrality measure, a coordinator agency is the most important actor in the network (Kapucu 2009).

Table 12 shows the top 10 organisations in the NDMS ranked by order of importance on their centrality values named as – degree, betweenness, closeness, and eigenvector centrality.

Table 12: Top 10 organisations in the NDMS Ranking (Hagbarg et al. 2018)

Total Degree Centrality	Out-Degree Centrality
NEMC	NEMC
R&SS	R&SS
MRPHS	GEMCS
HAZMAT	HAZMAT
GEMCS	MRPHS
In degree Centrality	Betweenness Centrality
NEMC	NEMC
ROP	R&SS
MODef	MRPHS
MOHlth	S&RS
Municipal	CIS
Closeness Centrality	Eigenvector Centrality
NEMC	MODef
ROP	NEMC
MODef	SQU
MOHlth	ROP
Municipl	Private Sector

From Table 12 above, **degree centrality** calculates the number of times an actor has, then **in-degree centrality** calculates the number of times that an actor receives from other actors, while **out-degree centrality** calculates the number of times an actor sends to other actors (Borgatti et al. 2013). The top organisations evaluated by in-degree centrality in the NEMP network, include the National Emergency Management Centre (NEMC), the Royal Oman Police (ROP), and the Ministry of Defence (MODef). On the other hand, organisations with high out-degree centrality scores include NEMC, which is one of the most central organisations, and the Relief and Shelter Sector (R&SS), Governorate Emergency Management Committees (GEMCS), and HAZMAT Sector. It means the organisations have the reputation and influence other members in the network (Wasserman and Faust 1994).

Betweenness centrality is another centrality measure that determines the potential for control as an actor who is high in “betweenness” can act as a gatekeeper controlling the flow of

resources between the alters that it connects. In other words, it can serve as a mediator, information broker, or boundary spanner among the organisations (Ciurean et al. 2013). Regarding betweenness centrality, the top organisations in the NEMP network are the National Emergency Management Centre NEMC, the Relief and Shelter Sector (R&SS), the Medical Response & Public Health Sector (MR&PHS), the Search & Rescue Sector (S&RS), and the Critical Infrastructure Sector (CIS). These sectors/organisations serve as the quickest links between other nodes, they serve as gatekeepers between organisations and control the flow of information and resources in the network. Moreover, these organisations have prominent roles in the network to the extent that lead to the network’s destruction if removed from the system. In the alternative, the network depends on these organisations to stay connected. This corroborates with the aims and expectations set by the Omani government in designing its post-2010 disaster management structure (NEMP 2018).

Besides, Figure 10 below shows the brokers of the network. In the diagram, the darker tones mean higher importance in this regard. As expected, NEMC is the primary organisation that helps the network stay connected, while others like the Relief and Shelter Sector (R&SS) and Critical Infrastructure Sector (CIS) have secondary roles and are less important. Uncoloured nodes are peripheral and are kept in the network by the existence of brokers.

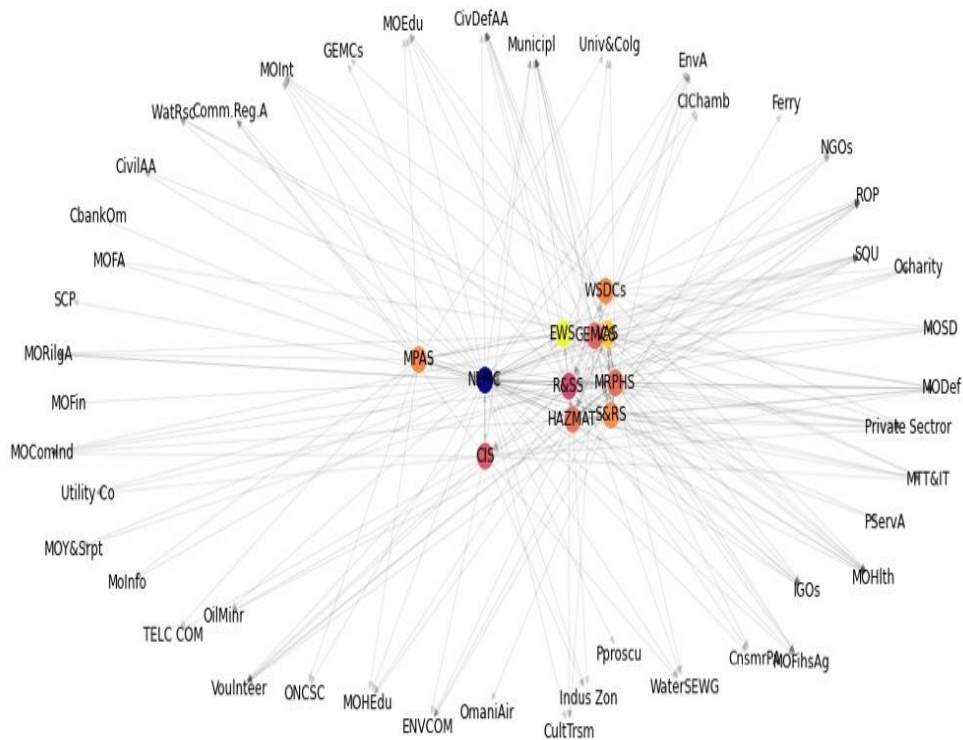


Figure 10: Brokers of NEMP Network (Hagberg et al. 2008)

Moreover, brokers or boundary spanner organisations are significant in disaster management systems. They advocate and facilitate cross-sector collaboration, and help enhance cooperation among various actors, including bridging disconnected organisations, coordinating network efforts, and information and resource exchange (Bryson and Crosby 2008). They should play a significant role in effective communications in emergency management. They are instrumental in information flow and resource sharing; thus, maintaining a dynamic and vibrant network (Kapucu 2006). Milward and Provan (1998) suggest a theoretical model for network effectiveness that having a leading central organisation in a network may lead to better network effectiveness (Milward and Provan 1998).

Closeness centrality measures how close an actor is to other network actors (Wasserman and Faust 1994). It is noted that nodes with high values of closeness centrality are likely to receive information more quickly than others, as there are fewer numbers of intermediaries to reach them (Kawulich 2005). In the ranking, the top organisations regarding closeness centrality are the National Emergency Management Centre (NEMC), Royal Oman Police (ROP), and the Ministry of Defence (MODef). The NEMC coordinates the efforts of NDMS, as well as maintains a connection with the central various government branches. Thus, it is considered the leader in terms of closeness centrality.

Lastly, organisations connected to groups with many connections can be identified using **Eigenvector centrality**. Organisations that are connected to isolated nodes will have a lower score compared to those organisations that are connected to well-connected nodes (Tajfel 1972). According to this criterion, the Ministry of Defence (MODef) is the leading organisation, which means that it is connected to many other well-connected organisations and thus is most likely to receive new information. Also, note that this is the only centrality score where NEMC does not qualify first. This could be because the Ministry of Defence, with its extensive resources, is represented in each sector. In NEMP, the degree of connectedness among the nodes is calculated as 0.48. A connectedness score of 1 suggests that all actors are reachable to each other, and a deviation from 1 indicates network fragmentation (Comfort and Hesse 2007b). The overall degree of centralization is 9.3%. The percentage of isolated nodes discussed before and the degree of centralization value indicate that many organisations were not communicating with other organisations. In conclusion, this network is sparse and has few nodes with many connections, while most connect to one or two others. Therefore, brokers are fundamental in keeping the network since most of the nodes are peripheral. This could explain the significant coordination responsibilities assigned to sector coordinators.

5.7 Conclusion

Oman's geographical location makes it extremely prone to natural hazards, such as tropical cyclones, torrential rains and floods, and regional Tsunamis. At the same time vulnerable to human-induced hazards resulting from oil spillage, chemical linkage, and radiation from industrial plants.

The study findings indicate that the emergency management model adopted in Oman has been developed from the broad principles of emergency management proposed by the United Nations International Strategy for Disaster Reduction (UNDRR) (A1, 2022).

Additionally, the research study showed that the disaster management strategy in ODMS is founded on five principles; priority for a risk reduction system, Emphasis on risk analysis, enhancing early warning and public awareness, enhancing response capabilities, and the use of knowledge and innovation to build a culture of safety and resilience.

Both interviews and documents analysis showed that the National Committee for Emergency Management NCEM is the official umbrella body for emergency management, was established in 1988, and is chaired by the Inspector General for Police and Customs (the equivalent of the Minister of Interior in most countries). The committee members comprised representatives from various ministries, agencies, armed forces, police, NGOs, and the private sector. The interviews conducted among officials from the emergency management system showed that the NDMS in Oman is a hierarchical system with a chain of command under the National Security Council. NCEM maintains a strict three-level command and control system at the national, governorate, and Wilayat levels. The key constituent parts of NDMS include the National Committee for Emergency Management (NCEM), The National Emergency Management Centre (NEMC), Governorate Emergency Management Committees (GEMCs), and function-based Sectors that include lead organisations and other supportive agencies.

This research finding from the interviewees confirmed that ODMS comprises eight sectors: Early Warning and Risk Reduction, Media and Public Awareness, Search and rescue, Medical Response and Public Health, Relief and shelter, Victims Affairs, HAZMAT, and Critical Infrastructure Sector. More findings make known that the general tasks and responsibilities of 8 sectors are broken into four categories: risk reduction, preparedness, response, and recovery, while additional roles depend on each sector's peculiarity. Moreover, empirical evidence

showed that sectors provide the structure for coordinating national inter-agency support for a national governorate response to a most important emergency.

Besides, the findings equally discovered that the eight sectors are integrated into the National Emergency Management Plan (NEMP). Findings from the document analysed and all participants interviewed disclosed that NEMP is the Omani official template for emergency management. It is the only legally referenced document for all actors within NDMS, and its overall objective is to ensure national resilience during hazards. The NEMP is activated during an emergency by the National Committee for Emergency Management (NCEM) via the National Emergency Management Centre (NEMC). The National Emergency Management Centre operates at the national level as the heart of the disaster management system in Oman. It is responsible for coordinating, monitoring, and planning preparedness activities carried out by the sector coordinators, including the primary and support agencies' focal points known as the "horizontal coordination." The NEMC is also the lead organisation for "vertical coordination", which involves engaging in activities to monitor and integrate the coordinators' efforts in the governorates.

Social network analysis of the Omani emergency management system according to the NEMP reveals that the density of this network is low which means that the EM network is relatively sparse. This could mean that information does not transmit very efficiently across the low-density organisation because it has to go from member to member, rather than diffusing rapidly from one member to another. The centralization of the EMS network implies low cohesion and high variability in centrality scores. The NEMC node has a bigger size than other nodes in the network, and most of the nodes in this network depend on that node particularly. This means that NEMC is the dominant lead or administrative organisation in the network. Regarding betweenness centrality, the top organisations in the NEMP network are NEMC, R & SS, MRPHS, S & RS, and CIS. These organisations serve as the quickest links between other nodes, they serve as gatekeepers between organisations and control the flow of information and resources in the network. As expected, NEMC is the primary organisation that helps the network stay connected, while others like R & SS and CIS have secondary roles and are less important.

Chapter 6 Findings and Discussion 2

6.1 Response Network

The implication of the findings from the research study on the Oman Disaster Management System acknowledged the importance of the response network in solving complex disaster management systems and other vital problems relating to disaster management in general. Thus, this chapter discusses these various complex issues discovered in the findings, centred on interactions among multiple stakeholders, examines both short- and long-term response plans, and investigates the response models as they apply in Oman. The results from the findings are structured accordingly in this chapter to simplify the discussion of significant facts, using tables and figures to support explanations about some specific discoveries in this study for a comprehensive understanding of the main argument to reflect the conceptual framework. The finding result of this research study focuses on three dimensions which are essential features inherent in social network theory: response network governance, response network coordination and collaborative functions, and response network structure and characteristics. Hence, Figure 11 represents lenses and criteria used to assess the effectiveness of intersectoral coordination in the Omani post-2010 response network.

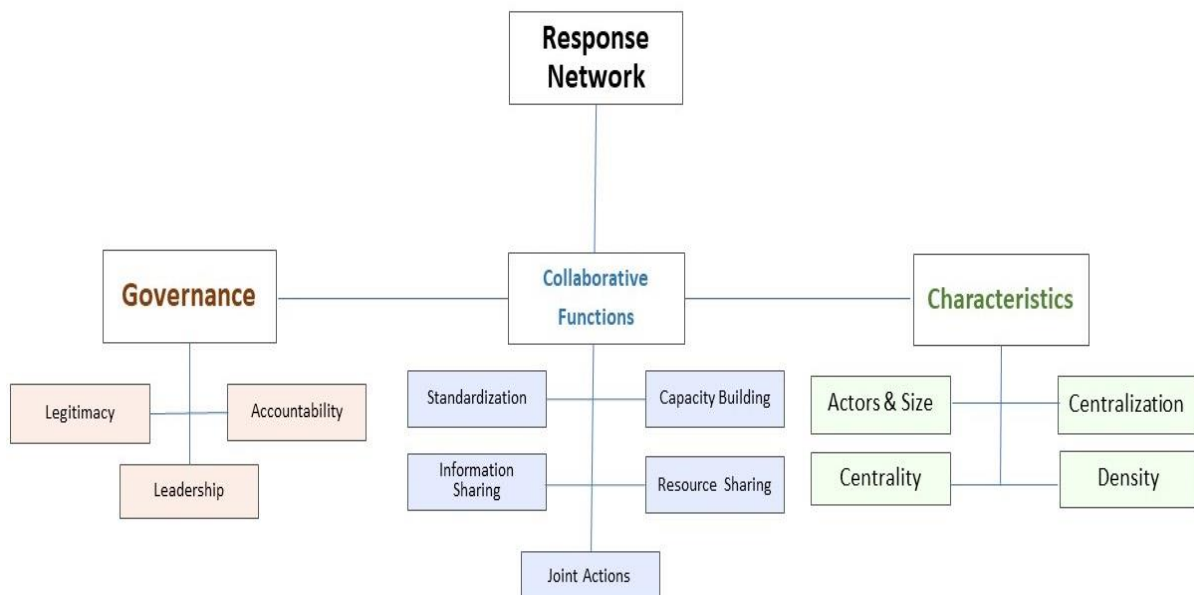


Figure 11: Lenses of Response Network Analysis (Author 2022)

6.2 Response Network Governance

This research finding demonstrates the challenge and application of a response network in an emergency. It shows that emergency response networks are a special type of inter-organisational public service networks that have been characterised as dynamic and more emergent than planned. It was observed from the research findings that response network governance was a veritable mechanism inherent in the inter-sectoral coordination of all sectors that made up the Oman Emergency Management System. It provides the legal input, leadership direction, trust, and synergy that require various sectors' approaches to a complex disaster situation. Although they are not completely independent from previously established relationships, response patterns, and structure may not be the same formal institutional arrangements (Kawulich 2005).

6.2.1 Legitimacy

An insight into the network's legitimacy justifies the Omani government's establishment of the NCEM, which is responsible for legislation, policies, and frameworks to enhance and give legal backing to the disaster management system and response network. The two Royal Decrees mentioned in the previous chapter (Decree No. 76 of 1991 and Decree No. 75 of 2008) guide the NCEM in developing response structures across the country.

According to the response from one of the interviewees (A2, 2022), a senior manager in NEMC confirmed that all GEMC chairs and sector leaders' actions and activities are guided by the two Royal Decrees. The Civil Defense Law stipulates that the Chairman of the NCEM is in charge of Command and Control of the national response to emergencies. Moreover, the Board of NCEM has the power to introduce any necessary measures to respond to an emergency successfully. It is ascertained from the interviews conducted that there is a government-approved emergency management structure, which includes, an incident management system and response plans for each sector. The NCEM response at all levels is determined by the provisions made available in the two promulgated laws. Therefore, at the national level, the response system includes the National Emergency Management Centre comprising eight sectors, including cross-sectoral organisations. The roles and responsibilities assigned to each sector "are in accordance with the plans [and guidelines], and as per the operational directive issued by the NEMC and any subsequent directives and orders issued by the NEMC" (A1, 2022).

Facts derived from documents analysed and interviews conducted confirmed the existence of a national disaster management strategy with a vision, mission, and objectives formulated in 2012 (A2, 2022). The NCEM strategy is annually assessed and reviewed to create opportunities for continuous improvement (A2, 2022). However, 80% of interviewees (n=38) maintained that the NCEM built and sustained a social identity and public presence across various sectors (A1, A2, S2, S5, A4, A5,2022). The NCEM has its insignia-like logo, and colour for public identification, as well as the website, along with active social media accounts. For instance, its Twitter account, which was created in 2014, is followed by more than 120,000 followers and is considered the main source of disaster management news and updates (S3,2022).

Moreover, NCEM has a public outreach program and is highly active in various public events, including domestic and international conferences. One interviewee posited that “NCEM is the official representative of Oman in the regional and international disaster management organisations/associations” (A2, 2022). This research study shows that NCEM represents Oman in the Gulf Cooperation Council Emergency Management Centre in Kuwait, the UNDRR, UNOCHA, and other international disaster management agencies (A1, A2, 2022). In addition, another senior official interviewed posited that NCEM maintains an active public communication program with a dedicated information officer and a public affairs department when asked if the agency has a public communication strategy in place. He stressed that. He further stressed that

“During emergencies, NCEM activates the Join Media Centre, which is considered a reliable and credible source for information related to emergency management”.

He underlined the significance of NCEM as a highly respected and widely accepted disaster management authority in Oman (S4, 2022). Besides, all interviewees (n=48) confirmed the legitimacy of NCEM as the solely recognized disaster response organisation in the country. For example, an official from one of the Emergency Management Authority stated that:

“NCEM’s functions, roles, responsibilities, and contributions to society’s needs are recognised not only by its members, also by those who work with the DMS, the public, including residence or expatriates” (A3, 2022).

The Response network in Oman, led by the NCEM, has the authority to conduct various transactions and activities relating to its functions. It includes activating response plans, mobilising various agencies’ resources and capabilities, and directing the public toward taking protective and preventative measures to effectively manage an emergency, save lives, and protect the public (A2, A3, S1, 2022). Findings from 50% of interviewees (n=24), mostly from

Wilayat Social Development Committees (WSDCs) confirmed that NCEM's efforts gain wide support from the community by direct participation in network efforts as volunteers and through donations. It shows the public acceptance, approval, and satisfaction with NCEM activities and instructions" (S34, S35, S36, S37, 2022). Therefore, the Omani Response networks are established on a solid foundation of legitimacy and trust. Moreover, it is privileged with the willingness of NCEM members, participating organisations, and the public to share information and resources which is evident in the broad participation of non-governmental organisations in emergency response (A3, S15, S16, 2022).

6.2.2. Accountability

It is revealed by all officials interviewed that Civil Defence Law clarifies that the NCEM is the official entity in Oman assigned to ensure readiness and national preparedness for potential major emergencies and disasters. The aim of the NCEM is stipulated in the National Emergency Management Plan (NEMP) as not only developing and maintaining a system that can deliver an immediate and effective response to emergencies and disasters but also one that can support communities for quick recovery from the impact of hazards. According to document analysis and interviews conducted, the Omani Civil Defence Law mandates the NCEM to develop and maintain a national disaster management plan and ensure national readiness to respond effectively to disasters and substantial emergencies (Article number (5) of Omani Civil Defence Law) (A1, S5, 2022). In contrast, it is the same law that is assigned to the Inspector General for Police & Customs (Chair of the NCEM). The enactment of bylaws related to the function and requirements concerning civil defence measures, including disaster management regulations, risk reduction measures, and disaster management plans which shall "identify roles and responsibilities of relevant ministries and agencies." (Articles (2) & (10) of Civil Defence Law).

In addition, the CDL sets out penalties for any violations of the CDL's provisions and bylaws including any obstruction to the execution of the national disaster management plan with imprisonment for a period not exceeding three years and a fine not exceeding five thousand Omani Rials, or one of these two punishments. (Article (20) of CDL) (A1, S5, 2022). The National Emergency Management Plan (NEMP) developed by the NCEM is to fulfil the mandate approved by the Sultan, the Cabinet of Ministers, and the National Security Council. Similarly, the NCEM always informed the Majlis Alshwra (State Assembly/Parliament) of its plans regarding the response and management of disasters or major emergencies. At the same

time, the organisation's activities are scrutinised by the Council of Ministers, the National Security Council, elected officials, the media, and the public (A1, A2, A1, S2, S5, A3, A4, 2022).

The National Emergency Management Plan (NEMP) is the primary reference document for all actors involved in Oman's emergency management system. When asked if they were aware of any strategies and plans for disaster management that have been developed in Oman, all participants confirmed their awareness of the NEMP developed by NCEM. The answer provided by the interviewee from one of the sectors reflects the general perception of participants:

“I am aware that the National Emergency Management Plan (NEMP) approved by the NCEM includes its national resilience objectives along with roles and responsibilities for various sectors and agencies. The NCEM oversees the operation of the NEMP and is in charge of coordinating efforts among agencies/ministries that are mandated by law to implement reduction measures for the risk/s that are under their scope of the speciality. The NCEM (which is a pool of undersecretaries representing a wide array of ministries and governorate departments chaired by the Inspector General for Police and Customs), is tasked as per the Civil Defence Law issued in 91, to coordinate disaster management efforts among various ministries and governorate departments” (S7, 2022.).

The view presented above also corresponds with the line of thought from documents reviewed in this study. For instance, Directive # 1 of NCEM issued by the Chairman of the NCEM in 2018 communicates the existence of NEMP, SOPs, and formal communication/coordination mechanisms (written directive). The NCEM plan also includes a detailed description of the structure of the emergency management system and how it is expected to operate. It indicates how using the function-based approach underlines the decision that emergency preparedness, response roles, and responsibilities should be assigned following the situation's specific needs (NEMP 2018).

The purpose of accountability is to ensure that the response network members are operating according to the original guiding principle outlined in the NEMP's plans. It involves the mechanism for dealing with emergencies and significant accidents that fall within their responsibilities, including activating the sectors they lead and maintaining support for response operations, depending on the case requirements and according to a directive issued by the

National Emergency Management Centre. (A1, A3, 2022): According to one of the interviewees' statements, the main guiding principle outlined in the NEMP enactment law is to ensure that response organisations are responsive, ready, and capable of carrying out an effective and swift response to emergencies (A2, 2022).

The available information on NCEM records indicates that NCEM official Memo 28 of 2018, approved by the Inspector General of Police and Customs in his capacity as the Chairman of the NCEM, confirmed the empowerment of the National Emergency Management Centre (NEMC) as the coordinating agency with the mandates to ensure the readiness of member organisations, sectors, and GEMCs. Besides, the NEMC is mandated to measure readiness and response performance via an annual program of exercises following standards and criteria identified in the NCEM performance assessment system (NEMP 2018). Likewise, facts from document analysis and interviews confirm that approved guidelines for sectors, such as GEMCs' Guideline, the Emergency Operation Centres (EOC) Guideline, and the Exercise Management Manual, have been clarified. Thus, the identified methodology, mechanisms, and other criteria assess readiness and response per member organisations' performance. The National Emergency Management Centre uses the above criteria as a general framework for verifying the readiness of Sectors and EM Committees and evaluating performance during the response and recovery stages (A1, A2, S3,2022).

Interviewees were asked about the issue of accountability of the response network, and they all acknowledged that all member organisations, sectors, and GEMCs are mandated to provide:

- 1- Annual Action Plan that identifies objectives and preparedness activities, including training and exercises.
- 2- Quarterly Performance Report that expresses progress made in the execution of the annual action plan.
- 3- At the end of each year, a meeting of the board of the NCEM discusses performance reports submitted by Sectors, GEMCs, and other member organisations. It produces the NCEM annual performance report that gets submitted to the Council of Ministers.

After each emergency response operation or a major exercise, an After-Action Report (AAR) is compiled from all participating organisations including recommendations to enhance performance and an assessment report developed according to the NCEM response performance assessment system. The findings from 70% of interviewees (n=33) disclosed that all AAR reports compiled are deliberated on during a joint after-action review session and a

final report will be submitted to the NCEM's board. The final report is discussed among NCEM members who take appropriate actions toward enhancing the system. (A1, S3, S4, A3, A4, 2022). A senior official from one of the response sectors confirmed that there are some instances where independent committees were set up to scrutinize specific response operations taken due to inefficiencies and weaknesses observed. For example, two national commissions of inquiry were tasked with assessing national emergency response to the 2007 and 2010 cyclones (S3,2022).

Findings from interviews indicate that each GEMC/sector/agency at the governorate level conducts internal meetings to address the progress made in relief and recovery operations. In addition, findings in the document analysis show that the NEMP requires every organisation participating in recovery to provide the NEMC with regular reports detailing recovery progress. The reports are expected to include an evaluation of performance against predefined key performance indicators, the effectiveness of business continuity solutions, quality control reports, and lessons learnt that might be useful in addressing future disasters (S5, 2022).

6.2.3. Leadership and Management

It is confirmed from the research findings that the performance of the NCEM during an emergency depends on the leadership and management style it has to offer in coordinating the various sectors under its supervision. Though the NCEM board comprises senior officials representing various public organisations, it is largely attached to the Royal Omani Police. It has a clear command and control system with the Inspector-General of Police and Customs (IGPC) as the Chairman of the Committee and a senior ROP officer as the head of NCEM's National Emergency Management Centre (NEMC). All NEMC staff are ROP officers (A1, A2, S1, S5, 2022). Hence, The National Emergency Management Centre (NEMC), assumes the role of the lead agency in the Omani emergency response system. This means that NCEM adopts a lead agency network governance structure, not shared governance, nor network administrative organisation structure (NAO).

According to the NCEM officials, the National Emergency Management Centre as a lead agency, works toward enhancing relationships with response network members and stakeholders by integrating and aligning their diverse goals and expectations with network goals and mission. (A2, S1, S8, 2022). On the other hand, emergency response is driven by a strict hierarchal/vertical command and control structure, the NCEM adopts a facilitative and inclusive management approach (A1, A3, S7, 2022). As discussed in the previous sections, the

National Emergency Management Centre (NEMC) manages the response network's accountability system and looks after the network's internal and external legitimacy.

Document analysis and interviews confirm that with its accessibility to resources and capabilities, social capital, and experience, the Royal Oman Police has leveraging power to take on the network leadership role. As the chair of the NCEM, ROP's supervisory role includes using its authority to promote collaboration, including establishing rules, aligning with organisational and network-level goals, and developing governance structures and relationships. The views of a significant number of 65% of interviewees (n=31) submitted that NEMC is active on behalf of the NCEM. It helps NCEM in connecting various components of the system, enhancing and facilitating cross-sector collaboration and cooperation, even ensuring members are working collectively toward achieving the common goals of the network, and that they are responsible for performing their roles and more.

Therefore, 80% of the interviewees (n=38) agreed that NEMC plays a moderator role by managing potential conflicts, mediating debates, addressing differences, and maintaining progressive relationships among members based on trust and commitment. They confirmed that the NEMC is instrumental in information flow and resource sharing and is essential in maintaining a dynamic and vibrant network. Besides, in unison, all interviewees ascertained the influential role of the ROP assuming emergency management system leadership, as many as 55% of the interviewees (n=26) recommend that Oman DMS adopt an external organisation as a network administrative organisation (NAO) governance style. They recommended that an independent entity (not the ROP) should be founded to govern the network and its activities.

However, NCEM acts as the converging point for executing all response activities in Oman. The command-and-control role of NCEM is well understood across the length and breadth of the system (A3, 2021). For instance, an interviewee from one of the sectors answered:

“In response and recovery operations we work very much in coordination, and collaboration with the NCEM and the NEMC. We are an active sector and an integral part of the disaster response system that NCEM directs, coordinates, and leads.”

Findings from all interviewees (n=48) interviewed also suggest that it is the understanding of the National Coordinators of the Sectors that, in an emergency, the overall objective of the NCEM is to activate the National Emergency Management Centre, who is empowered to manage, control, give direction and coordinate response activities at all levels, and coordinate

network efforts including information and resource exchange. This is made possible through an efficient leadership and management direction that is not entangled in unnecessary interference in the activities of various sectors under its control. All interviewees (n=48) indicated that they viewed that the military-style leadership encouraged and facilitated the standardisation of emergency response systems, operations procedures, command, and control systems. This leadership and management drive pattern is embedded in the inter-sector coordination concept that emphasizes cooperation among sectors during an emergency.

In all, the outcome of this research finding echoes that response network governance application to a complex emergency problem requires a comprehensive strategic management system design that accommodates all levels of government. The three-tiered management control system adopted by the NCEM as a response to the Oman disaster system has proven to be working based on an effective inter-sectoral network governance coordination and implementation of tasks. It is concerned with looking outward to the future from the organisational perspective and making decisions that guide disaster managers. The tactical managers design and implement ways to actualise the strategic plans. For example, participants in the interviews stated that the Oman response system is a single (three-tier) agency structure that occurs at the national (gold), regional (silver), and local (bronze) levels, respectively. Outside of this circle, the international level may be approached for assistance if the need arises (A2, 2021).

6.3 Response Network Coordination and Collaborative Functions

Emerging facts from the findings indicate that coordination and collaboration among stakeholders were significant practices as claimed by all interviewees (n=48). Interviewees were aware of the complexity involved in large numbers of stakeholders responding concurrently to meet the needs at the National, Governorate, and Wilayat levels. The list of stakeholders identified in the document analysis included numerous diverse organisations, such as government agencies, military, police, and civil society institutions. This section discusses and analyses the Response Network coordination and collaborative Functions.

Response network coordination and collaborative functions are explained by analysing the response network coordination structure, coordination mechanisms, and response network's collaborative functions, namely, standardization and Planning, capacity and knowledge building, information sharing, resources exchange, and integration of tasks. The diagram in Figure 12 beneath illustrates response network collaborative functions.

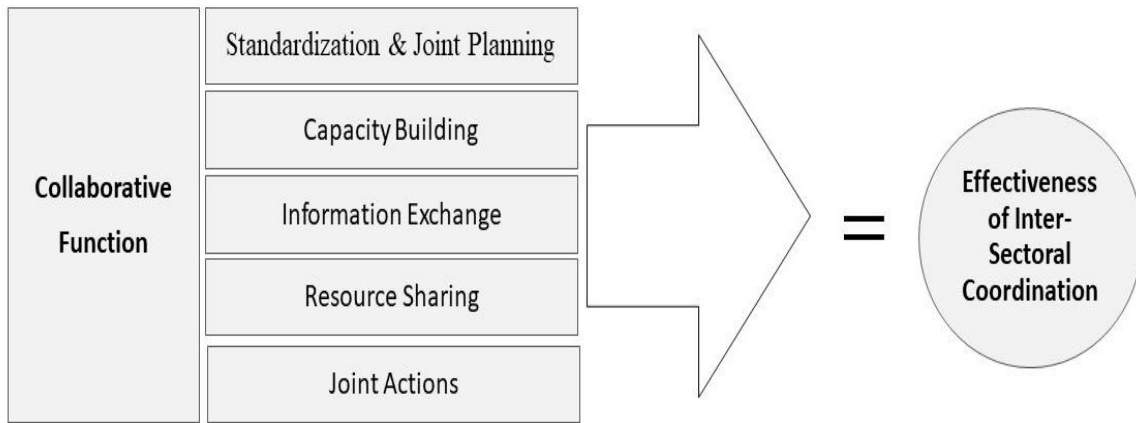


Figure 12: Response Network Collaborative Functions (Author 2022)

6.4 The Response Network Coordination System

Empirical data from findings shows that NCEM is the lead organisation in NDMS, and it is saddled with the responsibility to coordinate at the national level, as well as to monitor activities at sectoral and governorate levels. The National Emergency Management Centre (NEMC) is the most vital organ of NCEM, and it assists in facilitating relationships, networking, and actions among all the various organisations in the response network (A1, S3, 2022). As explained in the preceding section, the NEMP recognised three response levels in the emergency system: national, regional (Governorate), and local (Wilayat). The two enacted Royal Decrees establishing the system authorised all sectors to report to NCEM as the lead agency in the system. All interviewees (n=48) unanimously confirmed the existence of an active network comprising all the sectors, whereby all actors within NDMS have frequent interactions in the course of their duties.

The NEMC uses the coordination guidelines disaster response available in the NEMP as its principal reference document in coordination. Therefore, it allowed each Sector or GEMCs to develop and collaboration with the NEMC, following the guidelines specified jurisdiction for use in the response phase. For instance, the Critical Infrastructure Sector has a national coordinator. Moreover, it has a representative in every Governorate Emergency Management Committee (GEMC). The coordination systems will be explored in detail in the subsequent sections.

However, findings from the NEMP record showed that there are large numbers and diversity of organisations operating within the network system. Therefore, coordination is considered a

critical issue to enhance cooperation between government and non-government institutions at the national level, governorates, and wilayat level within the response network. Thus, the importance of coordination is to enhance and maintain cooperation through the establishment of a network of coordinators.

6.4.1 Response Coordination at the National Level

The NEMP identified the following national response coordination structure:

- 1- **The National Committee for Emergency Management (NCEM):** a strategic level collaboration platform that includes senior officials from various organisations and agencies mandated with taking strategic disaster management decisions, including DM policies, strategies, response frameworks, national plans, and doctrine.
- 2- **The National Emergency Management Coordinator:** being the Rapporteur of the National Committee for Emergency Management, the National Emergency Management Centre Director coordinates national emergency management efforts. This includes coordinating, monitoring, planning, and preparedness activities carried out by Sectors and primary and support agencies at the national level (horizontal coordination). His responsibilities also include overseeing preparedness activities carried out by GEMCs (vertical coordination). He coordinates national response and recovery operations during the response phase, including information sharing, resource management, and public information activities. The national emergency management coordinator reports directly to the chairman of the NCEM (A1, 2022).
- 3- **Sectors National Coordinators:** Each sector (of the eight sectors) has a "national" coordinator responsible for coordinating sector member organisations' preparedness activities and response operations. Sector coordinators supervise, coordinate, and communicate with their respective Sector Representatives in the eleven governorates. A senior official in CIS summarises the roles of the National Coordinators in each of the eight sectors in the response phase as follows:
 - i. Coordinate sector preparedness activities and ensure its readiness for a response.
 - ii. Coordinate sector capacity-building activities.
 - iii. Coordinate response and information sharing among various agencies in the sector and sector branches in the Govs & Wilayats.

- iv. Continuously providing partner agencies and sector branches with updated forecasts, operational directives, and other related information issued by the NEMC.
- v. Coordinate with other sectors in providing any assistance needed (i.e. power generator water, communications, medical staff, transportation, security escort, and more.) (S12, 2022).

On the other hand, Sector Coordinators report to the presiding officers of their respective sectors. They also, in turn, report to the National Emergency Management Coordinator to ensure the sector's readiness to respond to major emergencies (S1, S2, S3, S4, 2022). Sector Coordinators' coordination networks use "vertical coordination" with sector governorate representatives. While "horizontal coordination" is applied to representatives from member national organisations who, on their part, conduct "vertical coordination" with their respective organisations at the governorates and Wilayat levels. According to officials of the sectors interviewed, sector coordination networks are instrumental in enhancing prompt information sharing, resource exchange, and decision-making (A1,S3, S4, S5, S7, S8,2022).

4 Primary & Support Agency's National Focal Points: apart from sector coordinators, there are other significant players in the national emergency management coordination network, including coordinators for organisations such as ministries, authorities, and companies active in the governorates. In fact, "Focal Point" (FP) is a term used in the NEMP and SOPs to refer to a coordinator delegated by a principal agency for horizontal coordination, as well as cooperation with the representatives of the governorate agencies. The FP links the entity's national operation centre and branches in the governorates and Wilayat levels. The responsibilities of the Primary and Support organisation FPs include coordinating with the national emergency management coordinator concerning their organisation's preparedness, response, and recovery activities (A4, A5, S2, 2022). Figure 13 below shows a graphical arrangement in response network coordination structure at the national level.

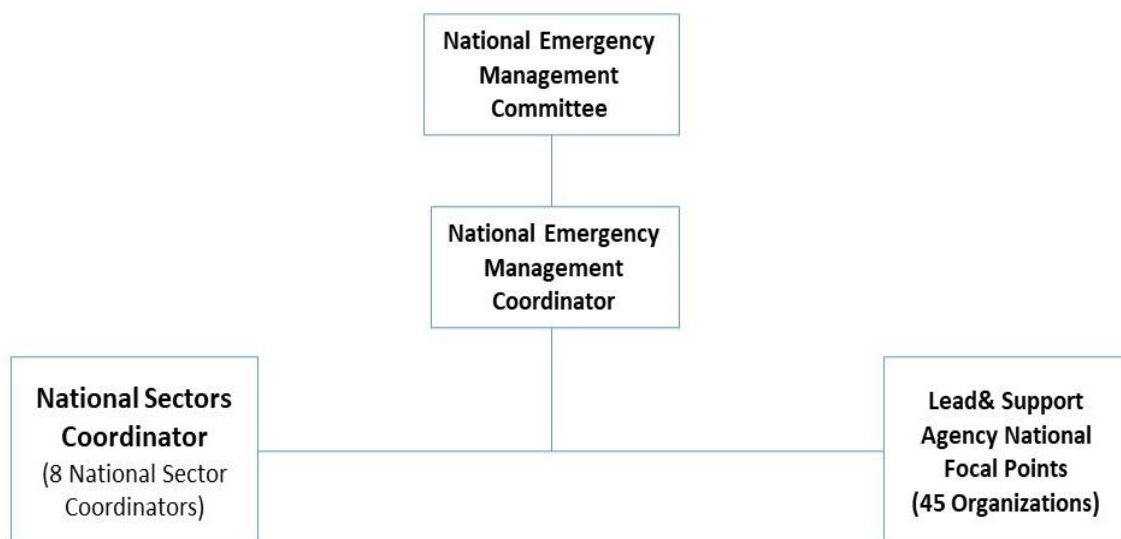


Figure 13: Response Network Coordination Structure at the National Level (NEMP 2018)

6.4.2 Response Coordination at the Governorate Level

Each Governorate Emergency Management Committee (GEMC) has a similar coordination structure to the one operating at the national level, including:

- 1- **Governorate Emergency Management Committees (GEMCs):** a collaboration platform that includes senior officials representing various organisations and agencies within the governorates. One of GEMC’s activities is holding periodic meetings where sector coordinators and representatives of the governorates’ primary and supportive organisations attend. Interviews confirm that the ROP chairs the GEMC, which sets up the GEMC. According to an official in the GEMCs, the role of the chairman is to:

“Supervise governorate preparedness and command and coordinate response efforts carried out by various sector’s member agencies in order to minimise impact and recovery efforts through cooperation, resource sharing, and facilitation of support among various government organisations, non-government organisations, and the private sector. The GEMC activates the governorate emergency management plan, the private sector. The GEMC activates the governorate centre, Sectors, and response agencies. The GEMC disseminates information among responding agencies, provides command and control, and coordinates support.” (A4, 2022)

- 2- **The Governorate Emergency Management Coordinator:** is the Rapporteur of the Governorate Emergency Management Committee. As the Director of Police Operation Departments in the Governorate, the governorate EM coordinator handles the horizontal and vertical emergency response coordination in the governorate. Findings from 75% of interviewees (n=36) reveal that the governorate EM coordinator is mandated with coordinating and monitoring emergency planning and preparedness activities carried out by the sectors and primary and support agencies within the jurisdiction of the governorate. During the response phase, he/she coordinates response joint planning activities and coordinates and facilitates response operations, including information sharing, resource exchange, and public information activities. The governorate emergency management coordinator reports to the chairman of the GEMC (the Governorate Police Commander), and the National Emergency Management Coordinator (A1, A5, 2021).
- 3- **Governorate Sectors Representative:** six out of the eight sectors have representatives in the 11 governorates. Moreover, findings from 75% of the interviewees (n=36) posited that the coordination of the activities of sectors in the Governorates is carried out by the most senior official of sector leading organisations in the governorate (i.e. DG of Governorate Health Services as the MR&PH Sector representative). Governorate Sectors Representatives are members of the GEMCs and are mandated with coordinating sector preparedness activities and response operations among sector member organisations within their respective governorates (A3,A4,A5, S7,S11, S23, 2022).
- 4- **Primary and Support Agency Governorate Representatives:** aside from sector coordinators, there are other significant players in the governorates, including coordinators for organisations such as ministries, authorities, and companies, active in the governorates. They are mandated with coordinating with the governorate emergency management coordinator their organisations' preparedness, response, and recovery activities. In addition, they supervise preparedness activities and response efforts exerted by their branches at the Wilayat (local level) in coordination with branch managers in each Wilayat within the jurisdiction of their respective governorates. They report to both the chair of the GEMC and their organisations' focal points at the national level. (A3, A4, A5, S34, S35, S37, 2022). Meanwhile, Figure. 14 highlights key features that constitute the response network coordination structure at the Governorate and Wilayat levels.

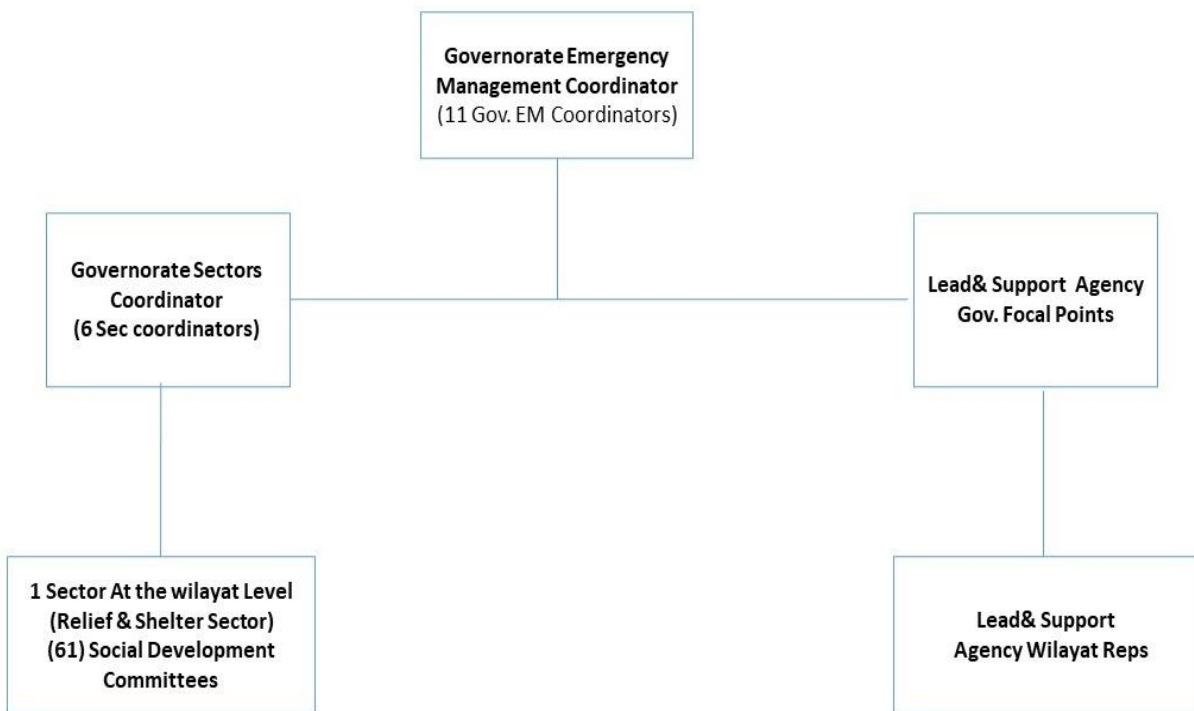


Figure 14: Response Network Coordination Structure at the Governorate and Wilayat Levels (NEMP 2018).

6.4.3 Response Coordination at Wilayat Level

Emergency response coordination in the Wilayat’s (local level) is minimal. According to all interviewees (n=48), there is no emergency management coordination body at the wilayat level yet. The Wilayat Social Development Committees (WSDCs) are representatives of only one sector, namely the Relief and Shelter Sector. The interview findings obtained from 80% of the participants (n=38) show that the work of the WSDCs relating to public awareness, relief and shelter operations, and the organisation of volunteer and charitable work are coordinated by the director of the local governor under the supervision of chairman of the Relief and Shelter Sector.

Other emergency response operations are carried out by police and civil defence search and rescue, utility companies, local hospitals, and other organisations. In short, no emergency management body that brings all entities under one roof. As illustrated in the diagram in Figure 15 below, NCEM does not have a presence at the local (Wilayat) level, nor there is another emergency coordinating body at the local level. Moreover, only one sector (the Relief and Shelter Sector) has a presence at the local level.

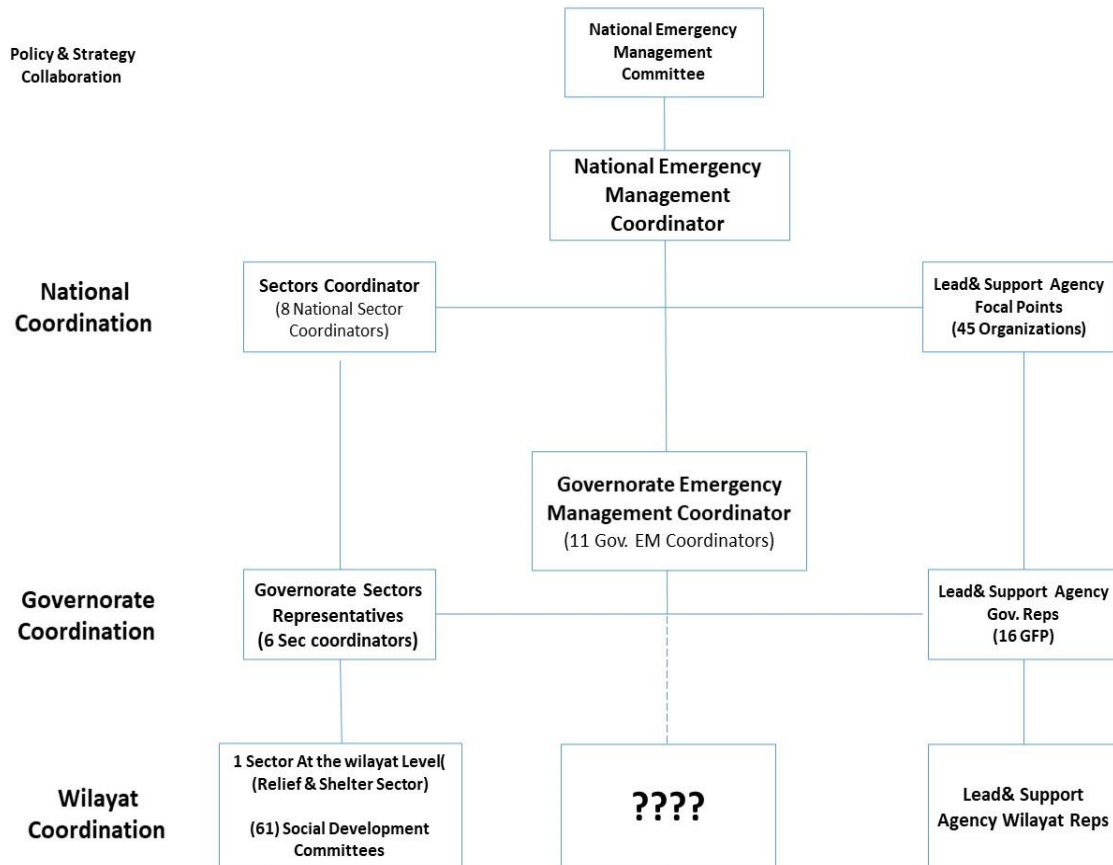


Figure 15: Response Network Coordination Structure (NEMP 2018)

6.4.4 Intersectoral Coordination

As discussed earlier, each sector has a National Coordinator, whose role regarding response is to address activities pertaining to readiness and preparedness of the sector. The coordinator works with the NEMC and other concerned government departments. According to one of the coordinators, “the main duty as the sector coordinator is to ensure that the sector is ready to respond to any disasters or major emergencies” (S6, 2022).

The National Emergency Management Centre (NEMC) uses the coordination guidelines for disaster response available in the NEMP as its principal reference document in the process of coordination. In addition to the coordination guidelines, each Sector, Governorate, or member agency has developed in line with the NEMC guidelines specific to its jurisdiction regarding disaster response. For each Sector, for instance, there is a sector plan, a critical infrastructure plan for each Governorate, and an emergency plan for all critical infrastructure organisations.

These plans identify coordination protocols and mechanisms among sector network member organisations (S24, S27, S28, 2022).

Information deduced from 80% of the officials (n=38) showed that response coordination starts from the forecast phase in a disaster management cycle and continues to the recovery phase. However, the interviewees acknowledged that coordination requires a good working synergy between various stakeholders. For instance, one of the interviewees stated that the National EM Centre:

“Has done a professional and unique job in achieving such high levels of collaboration among various emergency response sectors/agencies. It sustained and improved institutionalisation, legislations, and resources to enhance preparedness and integration” (S18, 2021).

Several issues were identified in each sector as hindering effective coordination. These issues are presented in detail in the preceding sections of this study. However, a critical issue that cuts across the sectors and the levels of government is the institutionalisation of coordination units. Thus, all interviewees (n=48) agreed there is a need to have well-staffed permanent official coordination units in lead agencies for each sector, and at the National, Governorate, and Wilayat Levels. Sector coordination is hindered because sector coordinators are not designated for the job, instead, they do it as additional work to their daily routines. The results show the disparity in performance (S3, S15, S20, S25, S30, 2022).

Progress in each sector depends on the coordinator’s willingness, character, and dedication. Therefore, NCEM needs to employ dedicated, qualified, and experienced personnel for coordination at the various levels.

6.5 Response Network Collaborative Functions

The Omani Response network collaboration and coordination functions are analysed by exploring four inter-organisational coordination functions; planning and standardisation, information sharing, resource sharing, and joint actions.

6.5.1 Planning and Decision Making

The response plans are part of a more comprehensive picture of plans developed with the assistance of formal mechanisms such as meetings, workshops, and conferences. This research has revealed two types of formal plans used in the Oman response system:

- The first type is highly comprehensive and constitutes a broad set of strategies known as ‘Management Plans.’ The Management Plans provide the strategic direction for the response activities of numerous and diverse collaborating partners in Oman. These strategies appear to have been devised to assume that the responding entities can assess a given situation and react according to the pre-plan arrangement. Hence, the strategies are adaptable and flexible.
- The second type of plan identified in the interviews and document analysis is the ‘Response Plan’. It focuses on response to specific threats to the well-being of individuals and communities.

The role of the NCEM as a policymaker implies that the NCEM has the responsibility of setting up structures to respond effectively in an emergency. According to 55% of interviewees (n=26) agreed that the NEMP is approved by the NCEM Board and provides details of the appropriate actions before, during, and after disasters. In particular, the NEMP sets out the emergency management doctrine and the roles and responsibilities of different entities and sectors in response to national emergencies. In another interview, a representative of the MR & PH Sector established that the NEMP recognised a command-and-control structure at the three levels, namely national, governorate, and Wilayat levels. Furthermore, he posited that authority for each level is specific and enhanced Operational Directives given by the NEMC for each disaster.

The NEMP is the final authoritative document concerning all aspects of disaster in Oman, including the response. The information derived from the document analysed identified the NEMP was developed at the NCEM Coordinators’ meetings in which all stakeholders were involved, to gain their commitment. The National Coordinator of one of the sectors remarked:

“We get to participate and discuss issues, challenges, and concerns in these meetings, which gives us a chance to be part of the planning and decision-making process” (S20,2022).

Response plans are developed at each level of disaster response under the direction and supervision of NCEM. A senior management official in the NEMC stated that the list of Management Plans includes:

“NEMP and the sector and agency plan at the national and governorate levels, and the relief and shelter plans at the Wilayat level.” (A2,2022)

NCEM and the Governorates have produced documents that guide roles and inter-relationships within the response network (A4, 2022). The document's aim is primarily to facilitate a common understanding among all sectors and participating organisations. The documents include:

At the National Level:

- National Emergency Management Plan (NEMP)
- Sector Plans at the national level
- Hazard-specific Response Plans (i.e., oil spills, radiological incidents, pandemics, etc).

At the Governorate Level:

- Governorate Emergency Management Plan (GEMP)
- Sector Plan at the governorate level

Document analysis confirmed that the NEMP provides the foundation for developing and implementing other Management Plans listed above. Among them are the two different Sector/Agency plans that are specifically developed for each sector as a mechanism for assigning roles and responsibilities and allocating resources to member agencies at the national and Governorate levels. The list also includes the GEMP, developed and maintained by the governorates' emergency management committees. The GEMP spells out the roles and responsibilities expected of all responding institutions in the governorate's response to emergencies. It is a unified and integrated plan at the governorate level and is compatible with the NEMP.

Both interviews and document analysis show that although the sector emergency management plans are developed and maintained by the eight sectors, they need to be approved by the NCEM. The sector plans prescribe how each sector would execute the roles and responsibilities in the NEMP. A complete sector plan includes a sector plan at the national level and a sector plan for each governorate. According to one of the sector coordinators, sector plans identify member agencies of the sector and prescribe the roles and responsibilities of each member agency (S4, 2022). It also lays down the command-and-control structure of the sector and the standard operating procedure (SOP) for the sector. Further findings showed that 80% of interviewees (n=38) proved that lead and supporting agencies' plans are similar to sector plans. However, they prescribe how the agency executes its roles and responsibilities assigned to them in the NEMP.

The governorate emergency management plans (GEMP) are developed and maintained by each governorate emergency management committee (GEMC). Apart from taking their cues from the NEMP and focusing on emergency response within the jurisdiction of the governorate, they take into consideration sector and lead agencies' plans for effective coordination and collaboration. The plans give details about the roles of the GEMC and the structure of the governorate's emergency management system.

Wilayat Social Development Committees' (WSDC) plans within each governorate. These are plans that are limited to the geographic jurisdiction of each Wilayat and are concerned with the specific subject matter of relief and shelter operations. The governorate plans stipulate that GEMCs must ensure preparedness by using the WSDCs concerning relief and shelter. Other emergency response functions are carried out by other agencies independently; there is no NCEM branch at the Wilayat level yet. The governorate plans to provide guidance for the utilization and coordination of the governorate resources, as well as resources obtained from the NCEM and other governorates.

Further findings from 70% of interviewees (n=33) confirm that the Sector Strategic Plan, which is developed by sector members, identifies the sector's vision, mission, and goals with respect to enhancing readiness and capabilities, as well as making sure the sector is capable of providing resources and services to address the needs of communities affected in a disaster (S3, S10, S15, 2022). In order to guarantee the preparedness of the response teams within their areas of expertise, the sectors are mandated to prepare, update, and implement response operation plans, including guides and detailed procedures for working in disaster situations and environments (S3, S7, S20, 2022).

Further findings in document reviews show that formal and informal mechanisms are frequently used in the response network. While during the preparedness phase, formal mechanisms are preferred and adopted, including official correspondences, meetings, planning sessions, workshops, training programs, and standardization of response tactics among various agencies. Besides, during the response phase, NEMC gives the directive to activate the response plans.

Findings show that the main activities in NEMC meetings are to enable sector coordinators and lead agency receive daily briefings, request support of resources, and review resource deployment efforts, among other common decision-making activities. A senior official in the

NEMC also stated that there are three types of decision-making meetings that regularly take place in disaster response, namely:

“First, policy “strategic” level meetings at the NCEM level including NCEM members (senior government officials) followed by joint planning meetings at the NEMC including Sector national coordinators. Second, tactical level joint planning meetings at the Sector level including sector network member agencies at the national level. Third, operational joint planning meetings at the GEMC level including GEMC members followed by sector level meetings at the governorate level.” (A2, 2022)

All the interviewees at the governorate level acknowledged that the GEMC holds meetings at the sector level in every emergency. During these response coordination meetings, decisions are made with regard to resources deployed and actions to be taken. Interviews also show that during an emergency, meetings are held daily and they provide briefings and a platform through which collaborating agencies present their requests for resources (A3, 2021).

6.5.2 Capacity Building

As discussed in the literature review, one of the common significant aspects of capacity building in inter-organisational networks in disaster management networks is knowledge management. One of the reasons for developing a disaster management network’s capacity enhance practitioners’ knowledge and experience. Inter-organisational networks usually provide knowledge sharing and management structure through continuous professional development programs and experience and best practices exchange sessions (Kapucu 2008).

Findings from 80% of interviewees (n=38) indicate that the NCEM’s approach, adopted from principles found in the NEMP, is to view preparedness as a continuous cycle of activities that include emergency planning, staff training, exercising, assessment, and remedial actions (A1, A2, A3, A4, A5, 2022). According to a senior official from the NEMC, capacity enhancement focuses on the enhancement of capabilities of people and institutions to improve their competence and disaster management capacities, and this is the main objective of preparedness activities. As part of this approach, the key objective is to enhance the resources, knowledge, and skills of NDMS member organisations and, at the same time to develop plans, standard operating procedures, and guidelines that unambiguously spell out the roles and responsibilities of participating agencies. The approach also views effective coordination, cooperation, and

integration among various responders as essential to attaining a high degree of readiness and preparedness for emergencies and disasters (A1, A2, 2022).

According to an official from the Search and Rescue Sector, a significant aspect of NCEM's capacity-building efforts is strengthening the institutional and organisational structure of the disaster management system, staffing, and resources and funding of training programs and regular drills for the emergency operations centres' staff, Sectors, and GEMCS. At the same time, strengthening the disaster response force, setting up joint decision support systems, and standard emergency operation centres to integrate and analyse information from multiple sources in an integrated geospatial system (S6, 2022).

All eight sectors are involved in capacity enhancement for disasters and emergencies. Indeed, document analysis shows they all have a common objective when it comes to readiness and preparedness, which is to:

“Coordinate the efforts of preparedness, response, support, and attribution, and ensure the availability of the capabilities and resources of the participating parties needed to deal optimally with the situation” (NEMP, 2018, p. 45).

A representative of the Relief and Shelter Sector stated that his sector is more pro-active in capacity building than other sectors because it is the only sector that works with communities through WSDCs to enhance communities' capabilities and awareness (S16,2025). The head of the R&S sector supervises the work of each WSDC related to capacity building, as well as activities that fall under the capacity building in the Wilayat, which include identification of the areas that face potential hazards. At the same time, working with competent authorities in evacuating people from areas that face the impacts of hazards, identifying safe and appropriate shelters to be used in a disaster or emergency, and ensuring shelters are equipped with necessary supplies and equipment.

Besides, the involvement of public agencies in disaster management, charitable and humanitarian organisations, and other civil initiatives respond to disasters and emergencies. Hence, the WSDCs must coordinate the capacity-building activities of such organisations. 90% of the interviewees (n=43) formed the majority that believes the capacity-building activities have been effective and contributed to the development of collaboration among various emergency response sectors and agencies. However, one of the senior managers interviewed notes that collaboration can be maintained and enhanced. In as much, there is an adequate budget for joint training courses and exercises are provided (S6 2022, A2 2022, and A5 2022).

Capacity building concerning improving the response network resources is determined by the NCEM and stipulated in the NEMP. According to the NEMP, “each member organisation is mandated with enhancing its response capabilities using its budgets and as part of its development plans” (NEMP 2018). This principle is acknowledged by the interviewees stating that one of the challenges their organisations have is inadequate allocation of funds/budgets for effective capacity-building programs including critical assets (S4, S7, S24, S30, 2022). They assert that with the limited annual budgets allocated to our organisations by the government, it is almost impossible to allocate the necessary funds to finance the procurement of needed response resources. Therefore, they propose that the government, through the NCEM, should develop and execute a national capacity-building program directed toward enhancing response capabilities, especially regarding the acquisition of critical resources. An example of this was the procurement of the mobile hospital back in 2007 and the establishment of the National Urban Search and Rescue team in 2009 (S11, 2022).

6.5.3 Resource Sharing

Enhancing resource sharing is one of the main objectives and features of inter-organisational networks. The general principles of resource-sharing in the Omani EMS are stipulated in the NEMP. According to the NEMP, primary and support organisations are to “provide expertise, resources, and capabilities necessary to support and assist in response efforts” (NEMP 2018). A senior official from the NCEM emphasizes that:

“The main purposes of the establishment of the NCEM and the sector structure concept are enhanced response resources and capabilities by providing a platform to gather needed resources from member organisations”. He adds that “It is mandatory by the law and by NCEM rules that member organisations should make its resources available for the use of the NCEM once a state of emergency is declared” (A2, 2022).

Still, officials from the eight sectors postulated that the resource-sharing principle is one of the pillars of the sector concepts. They acknowledge the significance of the authority that the sector concept provides them with as sector-lead organisations are authorized to request, mobilize, and direct sector member organisation’s resources during emergencies. (S4, S8, S14, S28, S32, S33, 2021). However, one of the officials from the Shelter and Relief sector explains how resource sharing is well organised in this sector. He explains that:

“According to the sector plans and long-practiced norms, relief food items are provided by the Department of Food Reserve (MOAF), while non-food items are provided by Oman Charitable organisation in collaboration with other NGOs. Transportation of relief items is done by the Armed Forces and private transportation companies, and security of relief operations is done by the Royal Oman Police.” (S15, 2022).

Similar resource-sharing systems are practised in other sectors. However, 75% of interviewees (n=36) from the sectors criticize resource-sharing procedures since critical assets have to be approved by the top management of each organisation for every single request during an emergency (S5, S10, S15, S19, S24, S30, 2022). They claim that focal points at the NEMC should have more authority to mobilize critical assets. However, they agreed that it takes time and delays, affecting prompt response operations. An interview with one of the senior managers confirmed that the intense level of collaboration could be maintained to enhance the mobilisation of any critical assets required during a response, as long as it is directly requested by the NEMC’s commander who has the full authority to mobilize pre-designated critical resources without the need to have additional high-level approvals” (S4, 2022).

Regarding the issue of mutual aid agreements between Governorates and sectors, all interviewees (n=48) affirmed that such contracts do not exist. Senior officials from one of the sectors stressed that while the NEMP facilitates resource-sharing activities and the NEMC coordinates such activities, there is no formal system that regulates the exchange of resources among NDMS member organisations. He claims there is a critical weakness in the system, and further states that:

“There are many times when our request for resources from a member agency will be rejected. It is considered that disasters tend to unfold suddenly with a great level of uncertainty causing considerable strain on materials, equipment, etc., hence impacting on the effectiveness of collaboration among agencies” (S11, 2022).

Another interviewee posited that resource-sharing challenges are probably due to the majority of the sectors not having databases of their resources available at each member agency (S3,2022). Moreover, there are no central databases in NEMC that pool together all their resources (S6, 2022). Findings in the document analysis confirm that the current Oman Disaster Management System is highly centralised. Hence, resources are currently largely centralised, making it difficult for autonomous responses to emergencies from local or regional authorities.

6.5.4 Information sharing

According to all interviewees, The NCEM aims to increase coordination and communication during emergency response. According to senior officials from the NCEM, the performance of the NEMP functions depends upon a communication–coordination infrastructure being in place before the disaster occurs, supported by an organisational infrastructure of trained personnel and an updated knowledge base. Without such infrastructure, communication fails. Without coordination, the situation moves into chaos. While some organisational structures are essential to search and exchange information, flexibility to adapt to the changing conditions of emergencies is essential in crisis and emergency management (Kapucu et al. 2009; Vvon et al. 2008; Comfort and Kapucu 2006). The flow of information across organisational boundaries is critical to effective emergency coordination in dynamic disaster environments.

Findings from all interviewees (n=48) confirm that the disaster response process in Oman starts with the NCEM. It must be emphasised that although NCEM activates and runs the National EM Centre, the idea of centralism is also evident in the information management system. However, one of the interviewees alluded that the NEMC maintains command and control over the information system through mechanisms such as information sharing machinimas among various members of the NDMS, meetings, briefings, calls, and information sharing platforms, as well as official correspondences, and operational directives. The interviewee further stated that the mechanism is from the:

“NEMC to sector representatives, and other agency focal points, and among sector member agencies (horizontal information sharing) and between the sector at the national level and its branches in Govs and Wilayets (vertical information sharing).”

As the commanding and controlling office in response, the NEMC is tasked with quickly disseminating pertinent information, instructions, support, and guidance among the responding agencies. The majority of the participants in this study comprising 85% of the interviewees (n=40) concur that there is a well-established system of reporting and information-sharing among various participating agencies. However, the criticism is that the system is not yet automated. A network of Emergency Operations Centres (EOCs) connects the National Emergency Management Centre with GEMCS and all Sectors. In this study, all interviewees (n=48) believe that the communication system would be more effective if the latest gadgets in ICT were installed across the network since it is the primary medium for information-sharing, direction, and requests for assistance or support.

Further interview findings among 75% of interviewees (n=36) and document analysis show a standard EOC management system in all the sectors. Sixty-five percent of the interviewees believe the EOC management system is well-documented and effectively utilized across sectors and lead agencies in recent years (S33, 2022). According to one of the sector coordinators, the EOC management system has proven to be an instrumental and effective tool in enhancing information sharing, thus boosting cooperation and collaboration between lead agencies and organisations across sectors (S33, 2021).

During an emergency response, the National EM Plan “clearly” identifies the response phase related to information sharing as:

- 1- Ensure that member organisation coordinators report to the National Emergency Management Centre or other EOC as directed by the NEMC.
- 2- Provide the National EM Centre with continuous situational reports and updates on the effects and damages reports and response efforts (NEMP 2018).

The document analysis shows that lessons learnt in previous disasters in Oman reinforce the assertion that carrying out response activities requires effective command and control, coordination, communications, and resources management, which, in turn, requires comprehensive situational assessment and analysis. One of the main functions of the NEMC is to develop situational awareness reports of the common operating picture. According to the officials from the NEMC, this is done through extensive efforts to gather information from GEMCs, Sectors, and participating agencies. Such information gets analysed, and a daily situational report will be distributed to decision-makers and the public information officer. (A3, 2022)

In addition, there is a standalone communication system between the National EM Centre and the Governorate EM Centres. However, not all sectors are part of this government communications network. Sectors (i.e. MR&PH, R&S, CIS, EWS) still depend on commercial telecommunication networks (S27, S31, S33, 2022). This is a major challenge that needs to be addressed by the NCEM as redundant combination systems are the backbone for the success of any response efforts. According to 80% of the interviewees (n=38), there is a need to equip the enhance the response network with the latest telecommunications systems, including a secure IT information-sharing system and backup communication systems (S3, S15, S18, S26, 2022).

6.5.5 Joint actions

Document analysis and interviews indicate that the NEMC developed standards and guidelines at the operational level to enhance integration among various response agencies. This includes:

- Multi-causality Incident Response Framework
- Incident Command System (Incident Response System)
- Response Teams Guidelines.
- EOC Operation Guidelines (NEMP, 2018, A1, 2022)

The most important of which is the Incident Management System (IMS). The IMS program allowed a culture of joint institutional work aimed at unifying concepts, principles, and methodologies used during field response operations, including carrying out periodic training and practical exercises that ensure their preparedness in line with global standards. Within this framework, a unified response system setting unified working principles and mechanisms for response operations, both in Emergency Management Centres and in field operations, has been established (A, S3, A3, 2022).

The Incident Management System (IMS) is a standardized hierarchical structure that allows for a coordinated response by multiple organisations to organise and coordinate responses. The primary role of IMS is to establish planning and management functions for responding partners to work in a coordinated and systematic approach. These functions can include using common terminology, integrating communication media, creating a unified command structure, coordinating resource management and allocation, and planning (A1, A2, S3, S4, S5, A3, A4, 2022).

The function of IMS includes assigning an incident commander to manage response activities by assigning personnel, deploying equipment, obtaining additional resources, and coordinating with participating partners as needed. Often, the incident commander is the local police chief. Unified Command within IMS is used when there is a multi-agency response during a large disaster. Unified Command allows for the integration of Wilayat, the Governorate, and national agencies to operate under one overall management structure with greater authority (A2, A3, S3, S9, S35, S36, 2022).

Besides, Sectors are mandated to ensure that their response teams are structured and function according to the IMS directive and are well trained on the IMS standard model (A1, A2, A3, A4, S4, 2022).

All interviewees (n=48) confirmed no lack of clarity in the command-and-control structure of response coordination. Further findings from interviews conducted showed that most of the NEMC training has been on multi-agency response incidents. However, three national incident management teams have extensive training in various IMS functions (A1, 2022). Such training is organised for teams to enhance coordination and integration of response efforts through cooperation, resource sharing, and facilitation of support among the agencies.

Findings from the document analysis confirm a good level of collaboration and coordination during major emergencies. An example of effective joint actions is damage assessments. The explanation a representative of the R&S sector confirmed that as soon as the response phase is concluded, joint damage assessments and joint recovery planning are conducted among all responding agencies, with collaboration and coordination under the GEMC umbrella. The damage assessment also helps set priorities and allocate roles and responsibilities to all the agencies in the restoration phase of recovery.

Table 13 below is a summary of the roles of sectors during the response phase.

Table 13: Roles of Sectors in the Response to Disasters (Author 2022)

SECTOR	Sector Response and Recovery Roles
Early Warning Sector	<ol style="list-style-type: none"> 1. Providing early warning functions, including forecasts, alerts, public awareness activities, and supporting decision-making at the NCEM. 2. Continuously providing media with updated forecasts and precautionary measures to reduce risks and minimise the impact. 3. Participate in disaster response planning efforts at the NEMC.
Medical Response Sector	To coordinate response to multi-casualty incidents, as well as to detect, prevent, and respond to public health risks.
Search and Rescue Sector	<ol style="list-style-type: none"> 1. Answering rescue calls and requests, conducting searches for missing persons, and helping in evacuation efforts. 2. Coordinate response and information sharing among various agencies in the sector and sector branches in the Governorates and Wilayats. 3. Continuously providing partner agencies and sector branches with updated forecasts operational directives/ and other related information issued by the NEMC.

Relief & Shelter Sector	<ol style="list-style-type: none"> 1. Develop and coordinate the execution of the Sector Strategic Plan (which identifies the sector’s vision, mission, and goals in enhancing its readiness and capabilities and making sure that the sector is capable of providing shelter and relief to affected populations in any disaster) 2. Coordinating with various agencies (MOUs) concerning the provision of shelter facilities and relief items. 3. Coordinate with other sectors in providing any assistance needed
HAZMAT	Response to HAZMAT incidents
Victim’s Affair Sector	<ol style="list-style-type: none"> 1. Disaster and mass casualty victims’ identification and preservation of deceased. 2. Coordinate response and information sharing among various agencies in the respective sector and its branches in the Governorates and Wilayats.
CIS	Continuity and restoration of public services (electricity, water, communications, roads, and more).

6.6 Response Coordination Issues and Challenges

Information gathered from the interviews conducted showed that 67% of the interviewees (n=32) indicated an overall, well-structured emergency management system with emergency management plans at the national and governorate levels. However, there are significant gaps still to be addressed in the structure. For instance, while some Governorate Emergency Management Committees (GEMC) are developed and active, others are not on the same level, particularly in readiness, coordination, and collaboration. Consequently, there are broad variations in implementing national plans by GEMCs, Sectors, and lead agencies. The emergency management system/structure is not even formulated yet at the Wilayat (local level), except for the Relief and Shelter Sector which is represented in every Wilayat through the Social Development Committees.

However, the finding result shows that 80% of the participants (n=38) believe it is the responsibility of NCEM to close the gaps in the structure at all levels of government. The findings indicate that the current key challenge in filling these gaps is how to get all the GEMCs to operate more efficiently and effectively. A senior official in one of the WSDCs stated as follows:

“Coordination is good at the national, but it is very weak between the governorate and Wilayats and among Wilayat departments. The capacity of the GEMCs needs to be improved”(S25,2022).

Also, 70% of the interviewees (n=33) comprising of those interviewed at the sectoral level believed the sector/cluster concept provided a good platform for coordination in the response phase. However, they also noted that not all sectors are fully developed or in the same state of readiness, coordination, and collaboration. There is considerable unevenness and asymmetry across the sectors regarding levels of development and coordination, as well as between the national and local levels. Some sectors do not have representation in governorates. There are wide variations in the implementation of the national plan by sectors and lead agencies, even though there is an NCEM-developed NEM plan with guidelines for organisational structures and operating procedures.

For instance, the Media & Public Awareness Sector works at the national level only. While public information officers and media cells in each governorate as part of the incident response system. Moreover, the sector does not have branches at the governorate level. Another example that portrays the poor development of sectors is that, except for the Relief & Shelter Sector, the emergency management system/structure, sector has not yet been formulated at the Wilayat (local) level. Therefore, sectors do not exist at the local level.

The response-oriented sectors work with well-established response coordination units including the MRPHS, S & R Sector, CI Sector, and the R&S Sector. For instance, an official in the Relief & Shelter Sector stated:

“As a representative of member agencies/departments (horizontal coordination) and with sector branches in the eleven governorates (vertical coordination. The goal is to make sure that Oman in general and the R & S sector (at the national level, governorate level, and Wilayat level) is ready and capable of carrying out its roles and responsibilities assigned to it in the NEMP.” (S16,2022)

Another issue that was raised during the interviews is about the variety in performance and progress made in each sector. The performance of the sectors depends for the most part on the coordinator’s willingness, character, and dedication (A2,2022). Therefore, a salient issue that cuts across the sectors and the levels of government is the institutionalisation of coordination units. All interviewees (n=48) agreed there is a need to have well-staffed permanent official coordination units in lead agencies for each sector as well as at the National, Governorate, and

Wilayat Levels. (S1, S17, S30, 2022). Therefore, NCEM needs to employ dedicated, qualified, and experienced personnel for coordination at the various levels.

6.7 Response Network Characteristics

NEMP outlines the “formal” emergency management network structure. However, to understand the characteristics of the emergency response network in Oman and comprehend how inter-organisational coordination cooperates during the response phase, at the same time to know the extent primary organisations are involved during the response, and to compare the official EM structure with the practised structure during the response phase, the 48 interviewees were asked to identify organisations/sectors they considered most influential in the response phase and identify organisations/sectors they directly engage in response activities. Based on the answers gathered, a network matrix was developed as the basis for this network analysis. Table 14 below shows Response Network matrices.

Table 14: Response Network Matrices (Hagbarg et al. 2018)

{	EW S	NEM C	MPA S	S\&R S	MR\&PH S	R\&S S	VA S	CI S	HAZMA T	GEMC s	NEM C
EWS	0	0	0	0	0	0	0	0	0	0	0
NEMC	1	0	1	1	1	1	1	1	1	1	0
MPAS	0	0	0	0	0	0	0	0	0	0	0
S\&RS	0	0	0	0	0	0	0	0	0	0	0
MR\&PHS	0	0	0	0	0	0	0	0	0	0	0
R\&SS	0	0	0	0	0	0	0	0	0	0	0
VAS	0	0	0	0	0	0	0	0	0	0	0
CIS	1	0	1	0	1	1	1	0	1	1	1
HAZMAT	0	0	0	0	0	0	0	0	0	0	0
GEMCs	0	0	0	1	1	1	1	1	0	0	1
NEMC	0	0	0	0	0	0	0	0	0	0	0
EWS	0	0	1	0	1	1	0	1	1	0	1
MPAS	1	0	0	1	1	1	0	1	1	0	1
S\&RS	0	0	1	0	0	0	1	0	1	1	1
MR\&PHS	1	0	1	0	0	1	1	0	1	1	1
R\&SS	0	0	1	0	1	0	0	0	0	1	0
VAS	0	0	1	1	1	0	0	0	1	1	0
HAZMAT	1	0	0	1	1	0	1	0	0	1	1
ROP	1	0	1	1	1	1	1	0	0	1	1
WSDCs	0	0	0	0	1	1	0	0	0	1	0
MODef	1	0	1	1	1	1	1	1	1	1	1

MOInt	0	0	1	0	0	1	0	0	0	1	0
MOHlth	0	0	0	0	0	0	0	0	0	0	0
MOSD	0	0	0	0	0	0	0	0	0	0	0
MoInfo	0	0	0	0	0	0	0	0	0	1	0
CivDefAA	1	0	0	0	1	0	1	0	1	1	0
CivilAA	0	0	0	0	0	0	0	0	1	0	0
MOCComInd	0	0	0	0	0	0	0	1	0	1	0
WatRsc	0	0	0	0	0	0	0	1	0	1	1
MOFihsAg	0	0	0	0	0	1	0	0	0	1	1
MOFA	1	0	0	0	0	0	1	0	0	0	0
EnvA	0	0	0	0	0	0	0	0	1	1	0
MOEdu	0	0	0	0	0	1	0	0	0	1	0
MOHEdu	0	0	0	0	0	1	0	0	0	0	0
Municipl	0	0	1	1	1	0	0	1	0	1	1
Comm.Reg. A	0	0	0	0	0	0	0	1	0	0	0
CultTrsm	1	0	0	0	0	1	1	0	0	1	0
CnsmrPA	0	0	0	0	0	1	0	0	0	1	0
MTT\&IT	1	0	0	1	0	0	0	1	0	1	1
SQU	0	0	0	0	1	0	1	0	1	0	0
Ocharity	0	0	0	0	0	1	0	0	0	1	0
ENVCOM	0	0	0	0	0	0	0	1	0	1	0
TELC COM	0	0	0	0	0	0	0	1	0	1	0
OmaniAir	0	0	0	0	1	0	0	0	0	0	0
Voulnteer	0	0	0	1	1	1	0	1	0	1	0
NGOs	0	0	0	0	1	1	0	1	0	1	0
Private Sectror	0	0	1	1	1	1	1	1	0	1	0
IGOs	0	0	0	0	1	0	1	0	0	0	0
MOY\&Srpt	0	0	0	0	0	0	0	0	0	1	0
MORilgA	0	0	1	0	1	0	0	0	0	1	0
WaterSEW G	0	0	0	0	0	0	0	1	0	1	0
Utility Co	0	0	0	0	0	0	0	1	0	1	0
OilMinr	1	0	0	0	1	0	0	0	1	0	1
Pproscu	0	0	0	0	0	0	0	0	0	1	0
Indus Zon	0	0	0	0	1	0	0	0	1	1	0
CIChamb	0	0	0	0	0	1	0	0	0	1	0
PservA	0	0	0	0	0	0	0	0	0	1	0

The findings from the 48 interviews conducted, observational data, and document analysis showed the sectors that participated in response operations during disasters. First, the content analyses of news reports were conducted to identify the organisations that participated during response efforts linked to Cyclone MeKuno and Luban, which hit Oman in 2018. Content analyses were carefully documented and recorded. Due to the inaccessibility of situational reports, after-action reports, or inter-organisational communication records, the research had a subsequent interview with a senior official from the NEMC to corroborate the outcome of the interviews and the content analysis of the response network. During the interview of the forty-eight interviewees, content analyses, and subsequent interviews, indicated the major organisations that participated in the response operations, and verified the interactions between organisations in response operations.

The data entered into Network X, a network analysis software developed by Aric Hagberg, Pieter Swart, and Dan Schult. Figures (16 and 17) show the visual representation of interaction among fifty-seven organisations representing Oman’s emergency response network based on data provided by interviewees and content analysis. The network represents a pattern of inter-organisational coordination and relationships among the actors during emergency response.

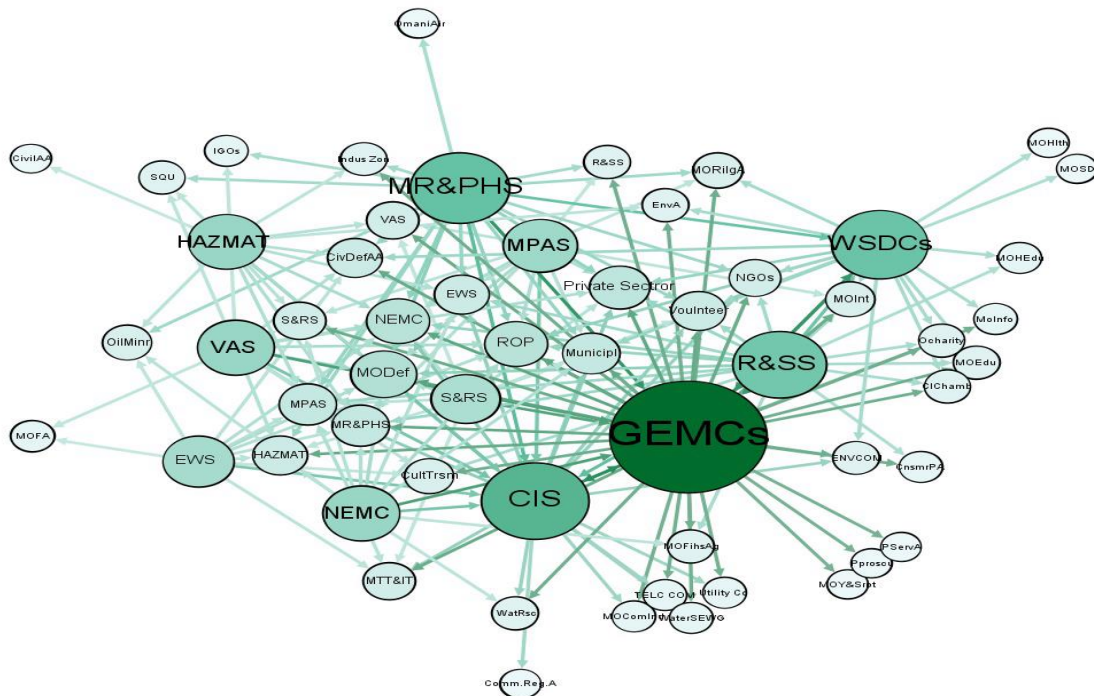


Figure 16: Graphical Representation of the Oman Response Network (Hagberg et al. 2008)

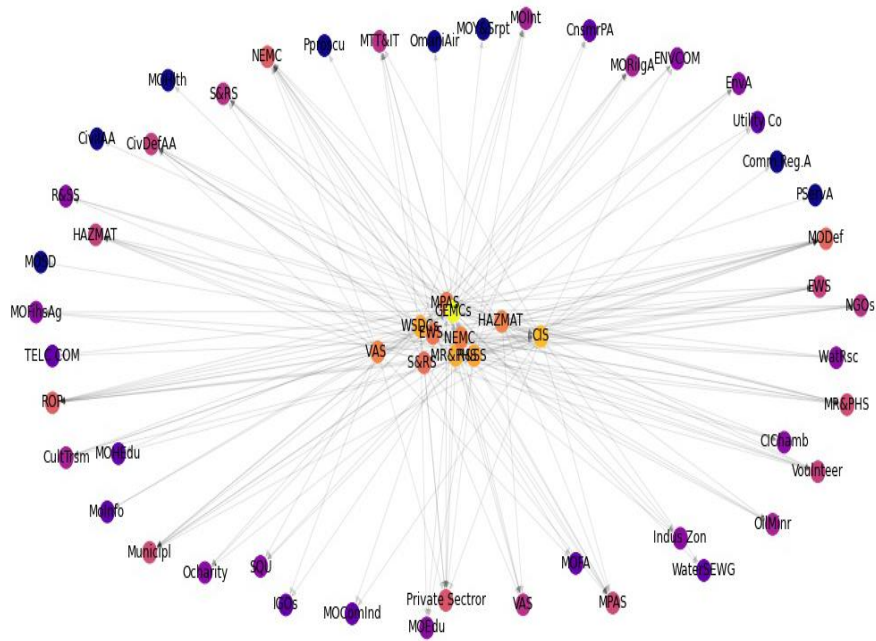


Figure 17: Graphical Representation of the Oman Response Network (Bastian et al. 2009)

Source: Data obtained from interviews (Gephi, Version 0.9.4, Bastian *et al.* 2009).

As seen in Figure 16, each node represents an organisation or sector in the response network representation. There are certain central nodes in the network, such as Governorate Emergency Management Committees (GEMCs), Critical Infrastructure Sector (CIS), Medical Response & Public Health Sector (MR & PHS), National Emergency Management Centre (NEMC), Wilayat Social Development Committees (WSDCs), and Relief & Shelter Sector (R&SS). These nodes have relatively more ties indicating that they are either primary organisations or have responsibilities in multiple sectors. From the above figure, we can observe that in the network matrix Governorate Emergency Management Committees (GEMCs) node is connected to most of the nodes in the network. Meaning that, in the response network, it is the Governorate Emergency Management Committees, not the National Emergency Management Center (NEMC), which is the most central network actor. This is different from the NEMP structure, where NEMC was the most central player in the network.

6.7.1 Density

Density describes the general level of connection among the points in a network. (Scott 2000; Wasserman and Faust 1994). The density of the response network is equal to ~0.06, which is very low, and similar to the “NEMP” network, both networks are quite sparse. This could mean

that information does not transmit very efficiently across the low-density organisation because it has to go from member to member, rather than diffusing rapidly from one member rapidly to from member to member rather than diffusing rapidly from one member to another.

6.7.2 Centralization

Centralization indicates the extent to which a few members hold the greatest number of connections in the network or the capacity a network is dominated by the connections of one or a few organisations or the power structure of the network (Borgatti et al. 2013, Comfort and Kapucu 2006). In response network, the degree of connectedness among the nodes is calculated as 0.226, meaning it is not tightly connected. The overall degree of centralization is 12%. The degree of centralization value indicates that many organisations were not communicating with other organisations when considering the official network, and both networks have low cohesion and high variability in centrality scores.

6.7.3 Centrality Measures

Analysing network centrality measures helps identify the response network's leading actors. However, Table 15 below shows the top five organisations in the response network ranked by importance on their centrality values: degree, betweenness, closeness, and eigenvector centrality. Analysis of degree centrality shows that organisations are supposed to have more interaction with others in the response network. The total degree of centrality calculated by Network X shows that Governorates Emergency Management Committees (GEMCs) have the highest degree of centrality and can be regarded as the most influential in the response network. The figure of the networks graph above specifically focuses on the degree of centrality, it shows that the GEMCs node has a bigger size compared to other nodes in the network, and most of the nodes in the network depend on that particular node. It means that GEMCs, not the NEMC, are the dominant lead organisation or administrative organisation in real response situations. The majority of interviewees reaffirmed the level of GEMCs contribution to disaster management as incident coordinators to ensure collaboration, cooperation, connectivity, and communication and source of information in the response network.

Table 15: Top five organisations under different centrality measures in the response network (Hagbarg et al. 2018)

Total Degree Centrality	Out-Degree Centrality
GEMCs	GEMCs
CIS	MR&PHS
MR&PHS	R&SS
WSDCs	WSDCs
R&SS	CIS
In degree Centrality	Betweenness Centrality
MODef	GEMCs
NEMC	CIS
ROP	WSDCs
CIS	EWs
Private Sector	NEMC
Closeness Centrality	Eigenvector Centrality
MODef	Private Sector
NEMC	Municipl
ROP	Volunteer
Private Sector	NGOs
CIS	ENVCOM

Organisations with high out-degree centrality scores (represents the number of links or connections emanating **from** a node) include Governorate EM Committees (GEMCs), Medical Response Sector (MR&PHS), Relief & Shelter Sector (R&SS), Wilayat Social Development Committees (WSDCs), and Critical Infrastructure Sector (CIS) as shown in Table 15 above. While the top organisations **in degree** centrality (depicting the number of links directed **to** a node, or the number of connections the node of interest receives from other nodes include) the Ministry of Defence (MODef), National Emergency Management Centre (NEMC), Royal Oman Police (ROP), Critical Infrastructure Sector (CIS), and the Private Sector. Regarding betweenness centrality (measures the extent to which a particular node lies between the various other nodes of the network), the top organisations are Governorate EM Committees (GEMCs), Critical Infrastructure Sector (CIS), Wilayat Social Development Committees (WSDCs), Early Warning Sector (EWS) and National Emergency Management Centre (NEMC). These

organisations provided the quickest link between nodes served as gatekeepers between organisations, and controlled the network's flow of information and resources.

Figure 18 below shows the existence of brokers in the network. The darker tones mean higher importance in keeping the network connected. This is because uncoloured nodes are only kept in the network by the sole existence of brokers. The important brokers are the Early Warning Sector (EWS), Governorate EM Committees (GEMCs), Relief & Shelter Sector (R&SS), and Search and Rescue Sector (S & RS).

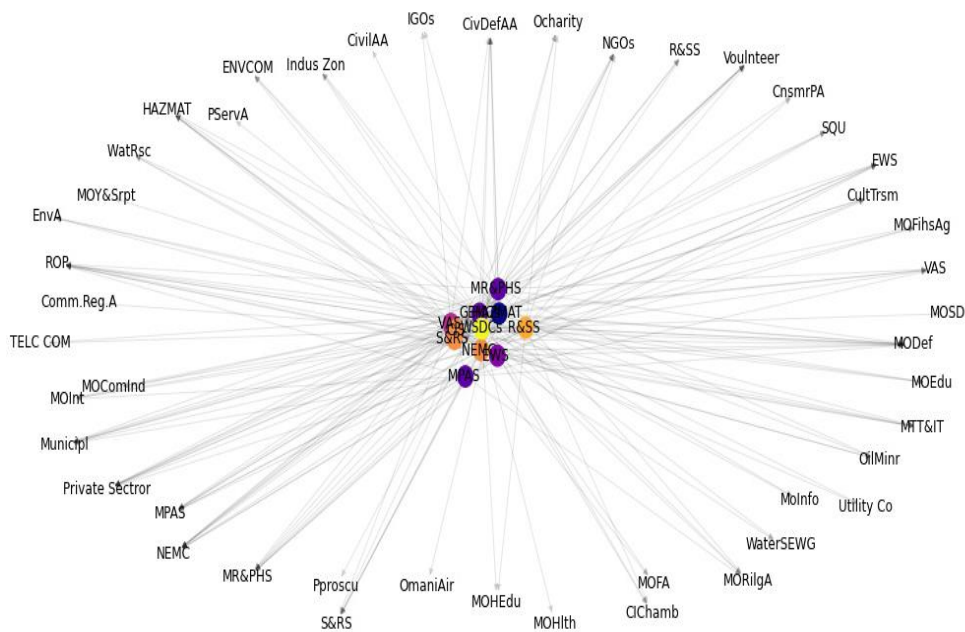


Figure 18: Brokers in the Response Network (Bastian et al. 2009)

There is some difference between gatekeepers or boundary spanners in the official EM and the response networks. While NEMC, R&SS, MRPHS, S&RS, and CIS are the gatekeepers in the NEMP network, in the response network it is Governorate EM Committees (GEMCs), Wilayat Social Development Committees (WSDCs), and Early Warning Sector (EWs) are active brokers. It is an interesting finding as Governorate EM Committees (GEMCs) and Wilayat Social Development Committees (WSDCs) have a prominent role in the network and are in charge of coordinating actual response operations as they occur within their jurisdictions. Moreover, this is a significant finding, according to the interviews, most of the capacity-building efforts are directed toward national-level organisations, while limited resources are allocated to governorates or local emergency management authorities.

Figures 19 & 20 demonstrate the similarity between the formal emergency management system in the NEMP and the response network perceived by the interviewees.

While Table 16 below shows the compromise between the formal emergency management network and the response network.

Table 16: Compromise between EMN and Response Network (Author 2022)

	Formal EMS	Response Network
Total Degree Centrality	NEMC, R&SS, MRPHS, HAZMAT, GEMCS	GEMCs, CIS, MR&PHS, WSDCs, R&SS
Density	The density of this network is 0.07 showing sparse connectedness.	The density of this network is 0.06 showing sparse connectedness.
Centralization	The overall degree of centralization is 9.3%. The percentage indicates that many organisations were not in communication with other organisations. NEMC node has a bigger size compared to others.	The overall degree of centralization is 12%. It indicates that several organisations were not in communication with other organisations.
Degree of connectedness	0. 0.48. affirmed a connectedness score of 1, which suggests that all actors are reachable to each other, while deviation from 1 indicates the fragmentation of the network.	0.226. confirmed a connectedness score of 1, which suggests all actors are reachable to each other, in contrast, deviation from 1 indicates the fragmentation of the network

6.8 Conclusion

The National Committee for Emergency Management (NCEM) operates at the national level and is the core of the disaster management system. It is responsible for coordinating, monitoring, and planning preparedness activities, carried out by the sector coordinators and representatives of the leading organisations in what is referred to as “horizontal coordination”.

Moreover, the NCEM is also the lead organisation for “vertical coordination”, which involves engaging in activities to monitor and integrate the coordinators’ efforts in the governorates.

The structure of the response system is critical for the continued existence of the affected communities in the aftermath of a disaster. Interviewees’ views highlight current trends and issues that may warrant further investigation into developing an optimal EMS. The general structure of emergency response in Oman is designed to facilitate the execution of a range of measures to protect life and property and provide support to communities that experience social disruption due to a disaster. This research indicates that emergency response activities in Oman are directed toward population protection. As confirmed from the interviews and document analysis, population protection includes an early warning, search and rescue, evacuation, provision of shelter and relief, and emergency medical care. These response activities occur at various levels, ranging from individuals and households to communities and organisations.

This research demonstrates that Oman has achieved an acceptable level of collaboration among various emergency response sectors and agencies in the post-2010 Omani EMS. However, it is still in a transitory state, and there is room for further improvement. On the other hand, the findings in this chapter of the research encapsulate the capability of the Oman DMS to respond and recover effectively in a disaster. The 48 interviewees’ views provided a better understanding of the current status of the Oman DMS and how best it can be expected to respond to future disasters. Furthermore, the findings also indicate that coordination in the response phase appears to be effective. There are various coordination mechanisms with predefined coordinators and focal points in place. In addition, there is evidence of good media management and an excellent public communication system. A network of Emergency Operation Centres (EOCs) connects the National Emergency Management Centre (NEMC) with the Governorate's EM Committees (GEMCs) and Sectors, used for information-sharing, direction, and requests for support or assistance.

Response coordination and collaboration among stakeholders in Oman take place at two levels. The first is at the pinnacle of ODMS, with the National Committee for Emergency Management (NCEM) in charge and the key instruments of collaboration and coordination being the National Emergency Management Centre (NEMC). The second level of response collaboration and cooperation happens at the Governorate level, and the GEMCs are in control. The GEMCs are used as the platform for coordination in their respective regions. Interviews suggest that the roles and responsibilities of the response coordinators at both levels are clear

and that the sectors and responding organisations are aware of the network of predefined coordinators and the focal points for coordination. The roles and responsibilities are defined in response plans that are well-publicised among responding parties.

Evidence unearthed during the COVID-19 pandemic indicates that the whole emergency response system was disregarded. A new supreme committee, known as the COVID Supreme Committee (Cov-19SC) was formed to tackle the complex issues arising from the pandemic. The committee is chaired by a senior minister who reports directly to HM the Sultan. Unlike the NCEM, members of the Cov-19SC are senior key ministers empowered with more authority and resources. The NDMS was used only in 3 specific ways:

1. Utilising the relief and shelter sector for providing quarantine facilities such as hotels, sports complexes, and schools.
2. Utilising WSDCs in coordinating and providing humanitarian relief for locked-up communities.
3. Limited activation of the Medical and Public Health Sectors in coordinating the hospitalisation of COVID cases, due to the shortage of medical supply, resource sharing, and vaccination distribution plans.

Both sectors were under the direct command and control of the Cov-19SC, not the NCEM. It appears to reflect the authorities' confidence level in the emergency system at the local level. Ultimately, a big vacuum needs to be filled at the Wilayat level. Still, all interviewees (n=48) believe that collaboration between various sectors can be improved further. Some of the suggestions for improvement included:

- Establishing an administrative unit in lead agencies and replacing current coordinators with dedicated staff and adequate resources. Most coordinators are not dedicated full-time. The coordinator's role concerning response is to ensure readiness and preparedness of the sector. They do this as an extra task outside their daily job routines.
- Developing solid official mechanisms for resource sharing to compel organisations to provide the necessary resources needed during an emergency.
- Provide a sufficient budget that is sufficient to conduct training and other preparedness activities.

Finally, the coordination at the national level is presently well structured. However, there is still a need for the governorate level to embrace the integrated sector concept to improve its performance. Interview findings show that most of the senior staff at the governorate level have

not been fully introduced to the idea. It is essential, for effective collaboration, for all senior staff at all levels of operations and in all responding agencies to be at par with the approach to R&R in ODMS. This would require more education, training, and practice.

Chapter 7 Findings and Discussion 3

7.1 Disaster Risk Reduction Network

This chapter discusses and analyses the findings from this research regarding the disaster risk

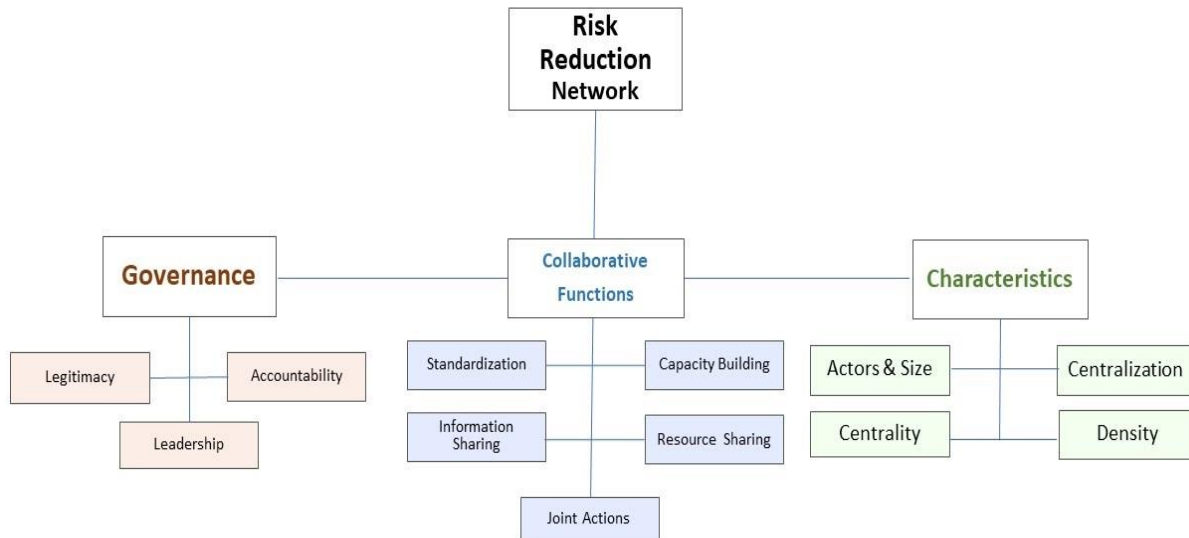


Figure 21: Disaster Risk Reduction Network Assessment Framework (Author 2022)

reduction network as it is applied to the Omani emergency management system. The focus of this chapter is on the conceptual framework, in which the study is conducted using three dimensions with fundamental elements representing three distinct domains: risk reduction network governance, risk reduction network coordination and collaborative functions, risk reduction network structure, and characteristics. The diagram in Figure 21 represents disaster risk reduction network assessment framework.

7.2 Oman Disaster Risk Reduction Approach

The findings from interviews and document analysis confirmed that there had been two significant efforts to improve some of the capabilities relating to disaster risk reduction.

- The first effort was the implementation of the 2007 Cyclone Guano Report compiled by the Royal Commission of Inquiry. The report highlighted the need to enhance risk reduction/risk mitigation measures in the country. Specifically, the report focused on flood protection measures, such as protective dams, drainage systems, and anti-flood road networks.
- The second effort originated from the outcome of the 2010 Royal Commission of Inquiry, which advocated for a new emergency management system in Oman. The new

system featured the introduction of new risk reduction measures that included effective early warning systems, risk mitigation measures, as well as community and business resilience enhancement.

However, the disaster risk reduction approach in ODMS is founded on three principles (A1, 2022):

- The first principle is to minimise the effects of hazards on life, the environment, and property.
- The second principle is that risk analysis should form the base for any emergency management process.
- The third principle is reliance on early warning systems and public awareness in minimising the impact of disasters.

As previously explained in detail, the Oman Disaster Management System is in Chapter 5, section 3. The document analysed in 5.4 confirmed that the National Emergency Management Plan (NEMP) sets out much of the strategic disaster management objectives and adopts a comprehensive disaster risk management approach that features these three principles. The ultimate goal of the NEMP is that of national resilience. According to a senior official in NEMC:

“Risk reduction is an integral component in disaster management. Disaster risk reduction principles are well defined in the NEMP. Risk reduction's roles and responsibilities are clearly defined for each participating organisation within the NDMS. National resilience is achieved through enhancing community and business resilience, respectively, and this requires a solid partnership with all stakeholders.”
(A2,2022)

The official further stated that there are six pillars in the risk reduction strategy to achieve resilience:

1. Develop risk reduction policies, legislations, and governance.
2. Inclusion of risk reduction measures in urban planning practices, development projects, and critical infrastructure facilities.
3. Developing criteria and indicators to monitor the fulfilment of risk reduction requirements in various development and infrastructure projects.
4. Enhance risk analysis activities and early warning systems.
5. Enhance risk reduction knowledge, innovation, and research. (N2,2022)

Interviews conducted confirmed that the approach in the NCEM is to view the risk reduction process, which constitutes two phases, namely primary and secondary mitigation:

- Primary mitigation measures include structural and non-structural mitigation measures.
- Secondary measures such as those conducted immediately before a cyclone occurs.

7.3. Risk Reduction Network Governance

The Risk Reduction Network Governance will be analysed from three perspectives: risk reduction network legitimacy, risk reduction network accountability, and risk reduction network leadership and management.

7.3.1 Legitimacy in the Risk Reduction Network

The NEMP provides the guiding document for all actors involved with NDMS. As mentioned in earlier chapters, according to the 1991 Civil Defence Law (CDL), NCEM is expected to function not only in disaster response but also in developing and implementing disaster risk mitigation measures. According to the CDL and NEMP, the key role of the NCEM in risk reduction is to develop risk reduction legislation, policies, and mitigation measures, as stipulated in article (2) of the CDL;

“The Civil Defence Measures include all procedures and precautions that achieve disaster risk management goals and objectives including; enactment of plans that aim to achieve public safety, manage disasters, and mitigate their effects” (Civil Defence Law 76/91. p 3). Furthermore, Article (4) of the same law states that *“The National Committee for Emergency Management (NCEM) and relevant committees in the Governorates take the responsibility of supervising the execution of Civil Defence Measures needed to achieve public safety”* (Civil Defence Law 76/91. p 4).

Therefore, according to the law and NEMP, the critical role of the NCEM in RR is to develop risk reduction legislation, policies, and measures. Findings from 80% of the interviewees (n=38) show that the role of the NCEM also includes the management of systems and governance issues to achieve integration among sectors, member agencies, and organisations. Further interview findings from the same set of interviewees also revealed that at the top of the ladder of the NCEM, in terms of coordination in disaster risk reduction/mitigation, is the **Early Warning Sector**. Aside from the Early Warning sector which is the focal point of NCEM to coordinate risk reduction/mitigation planning and execution with all stakeholders and NCEM member organisations.

According to a senior official from the Early Warning sector, NCEM is mandated with developing and supervising the implementation of risk reduction plans and measures. He stated that:

“Risk reduction is an integral component of the NEMP. The Plan identifies general risk reduction roles & responsibilities, along with specific ones for each member organisation. In fact, the Early Warning Sector is responsible – on behalf of the NCEM- for coordinating with risk owners various risk reduction activities.” (S5, 2022)

Another NCEM official asserts that NCEM is in charge of risk reduction/mitigation planning and execution. An interview with a senior official from the NCEM stated that:

“NCEM aims to enhance national resilience by adopting a comprehensive disaster risk reduction system that is based on a well-coordinated multi-sector concept, incorporating public agencies, the private sector, and NGOs, The Omani Emergency Management system works towards enhancing mitigation measures and early warning capabilities.” (A2,2022)

While a senior official from the EWS posited that,

“There is the National Emergency Management Plan (issued by the NCEM), which includes disaster risk reduction objectives along with roles and responsibilities for various sectors and agencies, of which public awareness and early warning is an integral part of these responsibilities. Having said so, it is a disaster management plan, not a risk reduction strategy.” (S1,2022)

Information obtained from 70% of the participants (n=33) of interviewees confirmed that ministries carry out primary risk mitigation measures without the direct involvement of the NCEM. It is only secondary measures, such as those conducted immediately before a cyclone occurs that the NCEM coordinates. Besides, the same category of interviewees sees the secondary measures as part of the response process, not primary risk reduction. Almost all the interviewees believe the NCEM has proven itself to be efficient in the coordination of networks for the response, not DRR, and is yet to present a holistic strategy for risk reduction. For instance, one of the National Coordinators says:

“In Oman, risk reduction is scattered among various Ministries. There is no central organisation that is mandated with developing a risk reduction strategy, or coordinating, assessing, and following up its implementation. The NCEM is more of a

response planning and coordination body, not really (at least not in practice) for risk reduction issues.” (S10,2022)

Interestingly, this view is shared by a senior official from the NCEM who stated that:

“NCEM's main mission is to prepare for and respond to major emergencies, while risk reduction is carried out by risk knower ministries. We cannot intervene and question how risk-knower ministries fulfil their risk reduction responsibilities, nor do we have the authority to do so. I mean what authority does NCEM have when it comes to the Municipalities to build drainage systems, or DG of water resources in deciding which dams to build and where? The same thing applies at the reconstruction phase (long recovery phase). It is the Council of Ministers that takes the decision to form a reconstruction Commission after each disaster to assess, plan for, and execute reconstruction rehabilitation projects. NCEM's responsibility is limited to ensure that there is an effective multi-agency response system.” (A3,2022)

One criterion for assessing network legitimacy is public outreach. Regarding a risk reduction public communications strategy that might enhance NCEM’s legitimacy as a risk reduction authority, an interviewee from the Media and Public Affairs confirmed that the NCEM’s public communication strategy focuses on preparedness and response activities. NCEM public communication strategy rarely covers risk reduction efforts. Also, “each risk owner, not the NCEM, is developing its own risk reduction public communication and public awareness plan” (S3, 2022).

According to one of the sectors’ interviewees, the NCEM’s social identity and public presence are attached to its response network not risk reduction efforts. He asserts that “NCEM social media accounts are almost inactive when there is no emergency except for news about public events or preparedness activities, i.e., training courses or exercise”. He elaborates that “there is no risk reduction public outreach program carried out by the NCEM” (S4,2022).

The RR objectives in NEMP cannot be achieved without sufficient resources. Therefore, the NEMP states that the responsibility of approving and providing funds lies with each ministry in coordination with the Supreme Council for Planning (SCP) and the Ministry of Finance, respectively. Interviews and document analysis show that the government gives top priority to funding for risk reduction projects. Accordingly, the process for RR funding is different from other processes. Findings from 90% of participants (n=43) in the interviews confirm that the

government appears to sidestep the hierarchy of the EMS when it comes to the RR funding process. In support of this assertion, an official from the CIS notes in his interview that:

“Since risk reduction needs significant capital funds, which the government usually grants to relevant ministries /risk owners, but not to the NCEM” (S24,2022)

Moreover, when asked about the acceptance of NCEM as a recognized risk reduction authority. An official from one of the Wilayat Social Development Committees stated that “NCEM’s risk reduction functions, roles, and responsibilities are not widely recognized by its member organisations nor by the public”. He adds “it is confirmed because NCEM is excluded from any public blame or inquiry regarding risk mitigation measures (i.e., dams, rain drainage systems, and more). These projects are considered part of the scope of certain government departments (S35, S37,2022). Hence, unlike the response network, there is no consensus among interviewees that NCEM is in charge of risk reduction responsibilities in Oman. This wide variation in recognizing risk reduction functions of the NCEM lessens its legitimacy (both internal legitimacy and external legitimacy) as a risk reduction entity which is evident in the risk reduction network structure.

7.3.2 Accountability in Risk Reduction Network

Findings from the document analysis show that the roles and responsibilities of all organisations participating in risk reduction are prescribed in the NEMP. In accordance with the laws, NEMP stipulates that all risk reduction practices are based on two sets of requirements, the requirements of mitigation measures put in place by the NCEM. Also, the requirements that emerge from the outcomes of periodic risk analyses (A1, S1 2022).

Document analysis of the 1991 Civil Defence Law confirms that CLD assigned the Civil Defence & Ambulance Authority (CDAA) to observe the execution of the “civil defence requirement” or disaster risk reduction measures in coordination with the other relative ministries. (CDL, Article (7)). The Civil Defence Law mandates the CDAA to scrutinise the execution of “fire” and “disasters” risk reduction measures enforce the provisions of Civil Defense law and its regulations, and inspect for violations of such regulations. (CDL, Article (11 & 12)). Furthermore, the CDL assigns the Inspector General for Police & Customs (as the Chair of the NCEM) with the issuance of the regulations related to risk reduction measures (CDL, Article (2)). Finally, Article (4) of the CDL mandates NCEM and its GEMCs to oversee the implementation of risk reduction measures in coordination with the relevant authorities (risk owners). (A2, A3, A4, S5, S30, 2022).

Therefore, according to the laws contained in (CDL) and NEMP, the key role of the NCEM in disaster risk reduction is to develop risk reduction legislation, policies, and measures. However, the above statement is not the case in reality because the NCEM is focused primarily on preparedness and response. NEMP confirmed that at the governorate level, every major assignment is delegated to the GEMCs under strict supervision by the NCEM. However, interview findings show that risk reduction is not made through the NCEM or its branches in the governorates. In contrast to the response phase, it is still done by each ministry independently of any central coordination.

At the Wilayat level, there is no presence for the NCEM or GEMCSs except for the Wilayat Social Development Committee, which is designated for relief and shelter operations. Even if EWS is the focal point for risk reduction/mitigation planning and execution, there are numerous other diverse organisations whose roles are essential to achieving the national risk reduction goals. Finding from 80% of those interviewed (n=38) asserted that it is the SCP that reviews, approves, and funds major structural risk reduction projects on behalf of the government of Oman. They further reveal that the role of the General Secretariat of the Supreme Council for Planning is to ensure adherence to the risk reduction guidelines identified in the National Urban Strategy. Apart from the SCP, government ministries (risk owners) whose areas of speciality reflect their roles in risk reduction/mitigation: “For example, Directorate General of Water Resources (Ministry of Fishers & Agriculture) is the entity responsible for flood risk reduction measures (i.e., dams, rain drainage systems, etc). Similarly, the Ministry of Health makes epidemics risk reduction efforts (including detection, warning, and public awareness, protective and mitigation measures, etc)” (S11, 2022).

According to an interviewee from the Early Warning Sector (R2 2022), much of the strategy for disaster risk reduction is developed in the following organisations:

- Supreme Committee for Planning (SCP)
- Ministry of Housing and Urban Planning
- Department of Municipalities
- Department of Water Resources
- Environment Authority
- Ministry of Health (MOH)
- Ministry of Agriculture & Fisheries
- Public Authority for Civil Defence & Ambulance

Evidently, the document analysis shows that while the NEMP includes risk reduction objectives and the roles and responsibilities assigned to the various ministries and agencies, such objectives and responsibilities are not implemented or coordinated by the NEMC. For example, there are public health-related by-laws enacted by the Ministry of Health. These by-laws govern and regulate the mitigation of hazards associated with epidemics and disease outbreaks. Document analysis shows that the by-laws stipulate that the MOH shall be the main entity and the competent authority for determining hazard mitigation measures for epidemics and disease outbreaks through the National Regulations Monitoring Committee (NRMC). Therefore, the NRMC is saddled with the responsibility of coordinating and implementing epidemic hazard mitigation efforts at the national level and not the NCEM. In an interview, a senior management official of MR&PH confirms this:

“Our public health risk reduction strategy and implementation is done independently of the NCEM. It is only when there is an outbreak that we activate the MR&PH Sector to respond. Thus, we are independent and not part of the NDMS when it comes to public health risk reduction activities. Risk reduction decisions are made according to the MOH bye-law requirements and in collaboration with concerned parties and stakeholders (domestically and internationally). We have designated departments that detect and implement prevention measures to tackle any public health risks. Very recent evidence for this principle is COVID-19 risk reduction measures that are developed and implemented by MOH. In fact, even the COVID-19 response was led and coordinated by MOH. NCEM was excluded from the COVID response operation. The government formed a Supreme Committee to manage COVID-19 mitigation and response efforts” (S11,2022).

This corroborates the earlier assertion that the NCEM is not in charge when it comes to RR.

In regard to the NCEM risk reduction performance assessment system or auditing mechanism stance, all interviewees confirm that the performance assessment system they are aware of relates to preparedness and response but not risk reduction. As one of the interviewees from the Critical Infrastructure Sector describes it

“While sectors and GEMCs are expected by the NEMC to develop and implement annual action plans, along with producing periodic reports to document the progress made in preparedness and response activities, risk reduction activities were never part of the scope of such plans or reports”. He adds “NCEM has not been scrutinized neither

by the government nor by the Alshwara Council (lower house of the parliament) or even the media for any risk reduction dereliction as it is widely conviction that risk owner ministries are to blame and that NCEM is a disaster response collaborative network” (S25, 2022).

Thus, findings revealed that 40 interviewees out of the 85% interviewed (n=48) confirm that the NCEM is in firm control of disaster response, and risk reduction in Oman. However, all public and private sector organisations are working either unilaterally, bilaterally, or multilaterally together on disaster risk reduction issues, and each is forming its risk reduction networks (S31, 2022). The NCEM focuses almost entirely on response, neglecting risk reduction, as risk reduction task is still undertaken by each ministry as part of executing its mandates. Thus, in practice, risk reduction efforts are scattered and not well coordinated or directed, unlike the case with response. See Table 17 for expanded information on each sector’s role in RR and some sector's response readiness, but not all participate actively in RR.

Table 17: Roles of Sectors in DRR (NEMP 2018)

SECTOR	Disaster Risk Reduction ROLE	LEVEL OF OPERATION
Early Warning Sector	1- Coordinate and integrate early warning systems and enhance decision-making in disaster management 2- DRR Coordinates various Ministries in developing and maintaining risk assessments 3- Work with the Media and Public Awareness Sector to improve public awareness	National only
Critical Infrastructure Sector	1- Identify Risks and interdependency between critical infrastructure facilities 2-Ensure that critical infrastructure facilities/organisations implement risk reduction measures	National and Governorate
HAZMAT Sector	To ensure the Civil Defence Act is implemented	National Only

Media & Public Awareness Sector	1. To coordinate the development of risk awareness programs. 2. Develop and execute a public information plan during disasters	l only
Medical Response & Public Health Sector	1. To assess public health risks 2. To preserve public health.	National and Governorate

The summary of Table 17 indicates that the differential roles of sectors in RR are not similar to response networks. For instance, the National Committee for Emergency Management (NCEM) risk reduction network does not have a solid accountability system. While the Civil Defence Law and the NEMP assign risk reduction roles and responsibilities to the NCEM and Civil Defence & Ambulance Authority (CDAA), neither the NCEM nor the CDAA is executing the enforcement of risk reduction measures. While some external accountability is evident in risk reduction laws, policies, mandates, administrative structure, regulations, and bylaws, internal accountability is limited to identifying risk reduction roles and responsibilities. However, there is evidence of a risk reduction governance system, auditing mechanisms, or professional assessment of risk reduction system performance.

7.3.3 Leadership and Management in Risk Reduction Network

Findings in previous chapters show that NEMP guidelines clarify that the leadership of the NCEM regarding coordination is vested in the director of the National Emergency Management Centre (NEMC). Thus, his function and task involve coordinating the work of various sectors, member agencies, and companies, as well as developing resilience across ODMS. Although primarily his role in the risk reduction and mitigation stage is based on findings from interviews conducted, which is to: “Coordinate between various NCEM member organisations/sectors activities related to the following:

- Risk assessments; are done by ministries, the EWS, and the Risk Assessment Working Group.
- Raise issues pertaining to risk reduction to respective ministries.
- Recommend legislation/policies that are needed to enhance RR.
- Compile and document risk reduction reports/studies.
- Follow public awareness efforts carried out by the MPAS and EWS.

- Enhance the relationship between early warning centres, the media, and emergency response authorities” (A1, A2, A1, S2,2022).

The document review for this study agreed that NCEM is the lead emergency management organisation. However, disaster risk reduction is a government-led effort that is intended to be implemented according to national development plans. The main objective of the 5-year development plan is to reduce losses suffered from disasters, such as loss of lives and destruction of social-economic, not excluding environmental assets of communities across the country. In addition, 95% of the interviewees (n=45) believe that Oman should have an RR strategy in place that is aligned with international best practices and frameworks such as the UNDRR Hyogo and Sandia initiatives.

It has been clarified in this research that the NCEM is mandated by law to supervise and coordinate risk reduction programs in Oman, and the organisation went further to create the Early Warning Sector to accomplish its given task. However, there are other existing mini-risk reduction networks in practice. Each is led by the 'risk owner' organisation and works toward identifying and implementing preventative and mitigative measures within the scope of the risk they acknowledge.

According to senior officials from the MRPH Sector, CI Sector, and HAZMAT Sector, NCEM’s National Emergency Management Centre has not practised its leadership roles or its authority according to the law, which is to coordinate and facilitate risk reduction functions. At the same time, it is incapable of utilising the accountability system or its internal and external legitimacy in coordinating risk reduction activities. Although the NEMC has leveraging power to take up a leadership role in the risk reduction network, instead, NEMC failed to exercise its authority to promote collaboration by establishing rules, aligning organisational and risk reduction network-level goals, and developing risk governance structures and relationships. According to 80% of interviewees (n=38), NEMC is inactive in connecting various risk reduction network members. Also, in enhancing and facilitating inter-organisational/cross-sector risk reduction collaboration and cooperation, including ensuring members work collectively toward achieving the common goals of the risk reduction network. (S10, S24, S30, 2022)

However, the majority of the interviewees which is 70% of the participants (n=33) assert that NEMC does not intervene to manage conflicts arising from risk reduction-related issues, nor it is instrumental in information flow and resource sharing of risk reduction-related functions. In

contrast, the majority of those interviewed which are 80% of the respondents (n=38) recommend that NEMC take over its leadership role in the risk reduction network as it did with the response network. Still, an independent entity (not the NCEM nor its NEMC) should be founded to govern the risk reduction network and its activities. Some propose the establishment of an independent government agency to handle risk reduction with specific responsibilities, dedicated staff, strong leadership, and a board to supervise its activities (A3, S10, S21, S24, S37, R4, 2022).

In conclusion, the governance of the risk reduction network in Oman is not as mature as it is with the response network. The risk reduction network does not enjoy much legitimacy as a risk reduction system, neither by its members nor by the public. Too, the risk reduction network does not have an effective accountability system or any sort of risk reduction auditing mechanism. The NCEM does not practice its leadership role as a central coordinating entity for all risk reduction activities in Oman as it does with the response network. The function of risk reduction is distributed across various ministries without coordination from the designated leading organisation in disaster management.

7.4 Risk Reduction Network Coordination and Collaborative Functions

7.4.1 The Risk Reduction Coordination System

As earlier discussed in subchapter 6.1 there is a significant difference between the risk reduction network mentioned in the NEMP blueprints and the practised one. The National Emergency Management Centre is the critical organ of NCEM for coordinating and facilitating relationships, networking, and actions among all the various organisations in the ODMS. Based on the NEMP guidelines, the leadership of the NCEM concerning risk reduction coordination is vested in the Early Warning Sector (EWS) Coordinator. EWS' Coordinator responsibilities involve coordinating the work of member agencies to enhance risk reduction practises. In risk reduction and mitigation, his role, according to interview findings, is to: "Coordinate among various NCEM member organisations/sectors activities related to the following:

- Coordinating Risk assessment efforts in collaboration with relevant ministries/risk owners.
- Compile and distribute information related to risk reduction.
- Coordinate risk reduction public awareness efforts in collaboration with the Media and Public Awareness Sector'(MPAS) coordinator.

- Enhance the relationship between early warning centres, the media, and emergency response authorities.” (S1,2022)

The Early Warning Sector (EWS) is mandated to coordinate risk reduction activities at the national level. The EWS is chaired by the Civil Aviation Authority and members representing risk owner organisations which include:

1. Directorate General of Water Resources (Ministry of Fisheries and Agriculture).
2. Earthquake Monitoring Centre - Sultan Qaboos University.
3. Department of Communicable Diseases (Ministry of Health).
4. Environment Authority
5. Department of fire and HAZMAT Prevention (Authority for Civil Defense and Ambulance)
6. Department of Biohazards (Ministry of Agriculture and Fisheries).
7. Media & Public Awareness Sector.

Figure 22 below shows an illustration of the risk reduction network structure as it is prescribed in the NEMP. However, there is a disparity in the information derived from interviews conducted, as 65% of the interviewees (n=31) indicated that the EWS has not been active in coordinating risk reduction efforts and activities since risk reduction is still practised under the pre-2010 institutional structure. A structure that allows risk reduction to devolve around ministries. For instance, the Civil Aviation Authority looks after meteorological and tsunami risk reduction efforts. It also develops the metrological and tsunami risk analysis, cyclone risk awareness programs, and educational curriculum. At the same time, it works with the Council of ministers to secure the necessary funds needed to enhance early metrological and tsunami warning capabilities (Interview with a senior official in CAA).

Similarly, the DG of Water Resources (Ministry of Agriculture & Fisheries), looks after flood risk reduction measures i.e., building protective dams and rainwater drainage systems while updating flash flood risk maps (R1,2022).

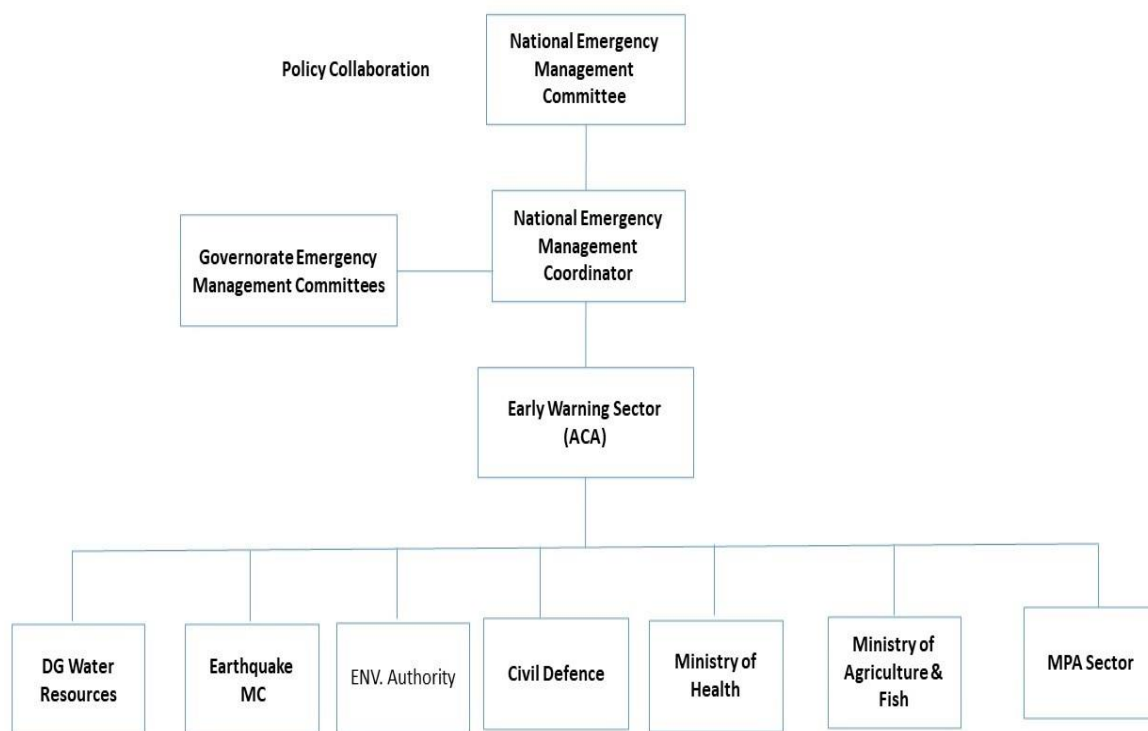


Figure 22: Risk reduction network according to the NEMP (NEMP 2018)

At the governorate level, the Chairman of one of the GEMC, reveals that the GEMCs are mandated in the (NEMP) to coordinate and direct various activities that promote risk reduction in the governorate. Such activities include implementing risk reduction and mitigation measures, development projects, and coordinating public awareness programs. However, the senior officials of the GEMCs interviewed acknowledged their mandatory role in RR, they stated that the GEMCs had not performed them well, at least not on the same level as the preparedness and response phase. The GCEM chairman says:

“According to the NEMP, my role in RR is to lead the coordination among various GCEM member organisations and sectors activities in relation to risk assessments, planning, and implementation of risk reduction strategies in respective ministries and other main organisations. It also includes the development of proposed legislation and policies needed to enhance RR in the governorate. Having said so, this is not yet practised. The focus has always been on preparedness and response activities. There are very few occasions when the GCEM submits RR related issues to the NCEM.”
(A5,2022)

80% of the interviewees (n=38) disclosed information that indicates that the Governorate EMS Coordinator carries out more response coordination duties than RR, suggesting that RR has

been neglected or not given the same attention, efforts, resources, and coordination that the response phase gets. The governorate EM coordinator's focus is on improving capacities and capabilities and ensuring the governorate's readiness and preparedness for an effective response to emergencies and disasters.

Both interviews and document analysis indicate that it is the duty of relevant risk owner organisations at the governorate level to develop risk reduction projects and activities within their respective governorates.

7.4.2. Risk Reduction Coordination Functions

In addition to the interviews conducted with NCEM, NEMC, Sectors, GEMCs, and WSDCs, the researcher conducted similar interviews with senior officials from risk owner Ministries to explore inter-organisational coordination functions pertaining to risk reduction in Oman. The following sections will explain the outcome of these interviews in relation to the main coordination functions.

7.4.3 Planning and Decision Making

The responsibility of NCEM has been clarified in earlier sections, which is to develop disaster management policies and plans. On the other hand, interviewees posited that they were unaware of any national risk reduction strategy integrated into NCEM's tasks (A1, A2, A4, A5, S4, S10, S15, S24, S30, R1, R3, 2022). However, RR planning and execution happen in a more controllable environment than the response phase. Findings from 70% of interviewees (n=33) confirmed that risk reduction is considered a long-term venture whose objectives include identifying risks/hazards and developing and implementing mitigation/reduction measures.

According to one of the interviewees from the risk owner organisations, top-level risk reduction plans, including regulatory instruments at the national level, are developed unilaterally with the Supreme Council for Planning (SCP). However, the development of financial instruments is done with the Cabinet officials and the Ministry of Finance.

Document analysis confirms the notion that the SCP develops the National Urban Development Strategy, which is the legislative and organisational risk reduction guiding principles for urban development projects and planning. Therefore, it appears that there is no coordinated planning

and collaborative decision-making, nor there is a national risk reduction strategy that guides risk reduction practices in Oman.

7.4.4 Information Sharing

As stated above, one of the tasks of the Early Warning Sector is to provide the NCEM with annual comprehensive risk assessment reports. However, the last comprehensive risk assessment was conducted at the national level as far back as 2010., this is one of the reasons for the lack of information and data needed to conduct detailed comprehensive multi-sector assessments as suggested by interviewees. They uphold that NCEM's member organisations are unwilling to share such "proprietary" risk-related information (S1, S2, R1, R2, R3, R5, 2022).

While each Governorate Committee for Emergency Management (GCEM) should perform risk assessments within their jurisdictions at the governorate level, according to all interviewees (n=48), there are no risk assessments yet at the governorate or Wilayat level. Some ministries do perform risk assessments within their domain, yet such assessments are not shared with the other ministries or with the NCEM. For instance, one of the senior management officers in the HAZMAT Sector shares:

"Risk assessment is done by the Civil Defence Authority (CDA) as a risk owner organisation but not as a HAZMAT Sector. We have our risk assessment tools including data, maps, and a GIS system. However; such risk assessment reports are used exclusively for the CDA operations." (S33, 2022)

Another official, this time from the MR & PH Sector, made similar remarks when asked how risks are identified and expressed in his sector. He stated that the sector, particularly the MOH has risk assessment tools to determine response types to accidents and public health issues such as communicable diseases. He alluded that the peculiar nature of the ministry means it must view risks in terms of the characteristics of the population of each jurisdictional area.

Several officials from risk owners' organisations expressed their efforts to conduct risk analysis within their scope, but they could not obtain the necessary information from relevant ministries/organisations. They concluded information sharing is minimal because the NCEM is inactive in coordinating information sharing for risk reduction purposes. (R1, R3, R4, R5, 2022). Unlike other countries where risk reduction authorities would make available to the

public risk maps, and risk assessment reports, the NEMC does not carry its role related to compiling and disseminating risk reduction-related publications (S34, S35, S37, 2022).

Sharing the outcome of the risk assessments is key information sharing in risk reduction networks. The research findings indicate risk identification and expression are conducted independently at all levels of the EMS. However, Interview findings show the compilation process is assigned to the Early Warning Sector, and the expectation from the EWS is the production of an annually updated Country Risk Register. The first Country Risk Register developed in 2010 has not been updated since it was drafted. Nevertheless, 80% of the participants (n=38) in this study agreed that NCEM could fulfil its role through proper information-sharing coordination among various risk reduction network members (S25, S6, S23, 2022).

7.4.5 Capacity Building

Capacity building in risk reduction during a disaster is described as “efforts to strengthen the competencies and skills of a target organisation, group or community so that the target could drive DRR efforts, or development of a sustainable way in the future” (Walker et al. 2004). Findings from the document analysis show that the 2007 Board of Inquiry instituted by the Government made some key recommendations concerning mitigation measures that needed to be adopted and implemented. The recommendations included the enhancement of early warning capabilities and the enhancement of business continuity systems in critical infrastructure facilities. In addition, emphasis was placed on the need to develop flood protection measures such as building protective dams, drainage systems, and anti-flood road networks because Oman is particularly vulnerable to hydrological hazards.

One of the main risk reduction objectives that Oman has been focusing on is the development of early warning capabilities. A senior official of the EWS stated that the National Multi-Hazard Early Warning Centre (NMHEWC) role is invaluable when it comes to forecasts and tracking of hazards. However, according to a senior official, this important system was supposed to be “an end-to-end” project. Meaning that “while tsunami detection technology was completed, we were not able to complement that with public warning systems nor other aspects related to coastal line warning signs, evacuation maps, or the identification of safe evacuation facilities” (S2,2022). He stated that the project could not be completed as the collective support needed is not available from the NCEM (S2,2022). Other officials from risk owner organisations made similar remarks. They assert that significant early warning projects, such

as flash flood early warning systems and radiological monitoring stations were not implemented due to similar reasons. In addition, inadequate funding and the unwillingness of other agencies to cooperate hindered the execution of significant risk-reduction projects (R1, R2, R3, R4, R5, 2022). They insinuate this to the absence of a national risk reduction strategy and the absence of a risk reduction coordination system.

7.4.6 Resources Sharing

The RR objectives in all disaster risk reduction plans cannot be achieved without sufficient resources. With the common challenges posed by the limitation of resources, inter-organisational networks, through effective coordination functions, play an essential role in facilitating resource sharing among member organisations. An example of coordinating resource sharing in risk reduction networks is collaboration and partnerships in executing disaster risk public awareness programs. Public awareness is a construct that appears in all phases of disaster management. Public awareness in the risk reduction phase is a continuous process of developing a culture of risk awareness. It is usually achieved by designing and implementing public education curricula through effective processes, lectures, site visits, and awareness week/day for specific hazards. Thus, public awareness in RR has a long-term focus and can be assessed by availability, access, and effective management. Thus, a dedicated sector within the OMES is responsible for coordinating media and public awareness activities, with specific roles and responsibilities to coordinate long-term risk reduction awareness programs. However; findings from 90% of interviewees (n=43) show that in practice, each agency coordinates bilaterally with the Ministry of Education, the Ministry of Information, and public communication platforms to develop risk education materials/activities within its scope.

According to a senior official of the MPAS, the sector's mandate is to raise public awareness. The official stated as follows:

“We are mandated to coordinate among various authorities to develop educational and awareness materials that enhance public awareness of the disasters/risks facing Oman. We can do this on two main fronts, working with authorities mandated with managing risk reduction and collaborating with educational institutions that can disseminate information. The authorities include organisations such as the MOH, which deals with epidemics and other public health risks, the National Early Warning Centre of the Civil Aviation Authority, and the Ministry of Education. They are concerned with meteorological and tsunami-related risks. There are also women's associations,

people with disability organisations, and children's organisations like the Omani UNICEF. So, one side would provide us with risk reduction related awareness materials while the other side would make sure that such materials are included in educational curriculums, academic programs and media awareness text, video, and audio formatted clips" (S4,2022).

Besides, further interview findings with other senior officials confirm what MPAS is supposed to be doing as inherent in its mandate. However; although the sector is very active and well-coordinated during response, it is not active in coordinating risk reduction activities such as public awareness programs(A2, 2022). The MPAS is not effective in collaborative planning with relevant risk owner organisations to plan and prioritise public awareness campaigns by pool resources, expertise, and data to create comprehensive cost-effective programs. This negatively affects the efficient allocation of resources like funding, manpower, and materials across various stakeholders (S25,2022). The NEMC and its sectors should enhance resource sharing and joint action in risk reduction-related activities by coordinating joint public awareness activities, and collaborate on events, workshops, and community activities that promote the public awareness objectives (S27, 2022).

In conclusion, both interviews and document analysis suggest that the mechanism for coordination in the risk reduction phase differs very much from the response phase discussed in the preceding chapter.

Statements recorded in the interviews suggest that Oman appears **not** to have a well-integrated and coordinated risk reduction system. The adoption of a multi-sectoral approach to risk reduction and mitigation implies a need to enhance the capability to coordinate the activities of the numerous actors and agents within the system. Although the actors strive for similar goals, they are diverse and have different modus operandi. Several interviewees confirm that although the NCEM places coordination and the ability to manage information in the risk reduction phase as a top priority, coordination does not happen as it should in the risk reduction phase. This contrasts with the interview findings in the response phase, which rate coordination as excellent.

A top official of the NEMC pointed out that the roles and responsibilities allocated to organisations participating in risk reduction are connected and interrelated. Hence, priority is placed on effective coordination. The case of detection and monitoring of hazards and early warning is a point at hand. Interviews recommend that the Early Warning Centres develop risk

assessment reports to spur governmental and private sector organisations to imbibe tasks that involve identifying preventive measures. Also, to minimise hazard impacts, raise public awareness of potential damages, find ways to prevent them, and provide data and information for decision-making. These tasks require effective coordination at the national, governorate, and Wilayat levels. However, findings from 70% of interviewees (n=33) identify the EWS as the sector responsible for risk reduction. Nevertheless, it has not taken any measures to perform the risk reduction roles and responsibilities described above.

7.5 Risk Reduction Network Structure and Characteristics

Understanding and comprehending the characteristics of the risk reduction network in Oman and exploring how inter-organisational coordination between the organisations works during the risk reduction phase is vital to this research. At the same time, to determine what primary organisations are involved in risk reduction, the interviewees were asked to identify the organisations/sectors that are considered the most influential in the risk reduction system and identify organisations/sectors they engage with directly in carrying out risk reduction activities. A network matrix was developed for this analysis based on the answers gathered as displayed in Table 18 which documents 19 organisations in the risk reduction system.

Table 18: Network Matrices (Hagbarg et al. 2018)

{	MPA S	EW S	CivilA A	SQ U	WatRs c	MHou s	Env A	CivDe f	MOHlt h	SC P	CoMins t
MPAS	0	1	0	0	0	0	0	0	0	0	0
EWS	1	0	1	1	0	0	0	0	0	0	0
CivilAA	0	1	0	0	0	0	0	0	0	0	0
SQU	1	1	1	0	0	0	0	1	0	0	0
WatRsc	0	1	0	0	0	1	0	0	0	0	0
Mhous	0	0	0	0	1	0	0	0	0	0	0
EnvA	0	1	0	0	0	0	0	1	0	0	0
CivDef	0	1	1	0	0	0	1	0	0	0	0
MOHlth	0	1	0	0	0	0	1	1	0	0	0
SCP	0	0	1	0	1	1	1	1	1	0	0
CoMinst	0	0	1	0	1	1	1	0	1	0	0
MHEdu	1	0	1	0	1	0	1	1	1	0	0
MHEdu.1	1	0	1	0	1	0	1	1	1	0	0
IGOs	0	0	1	0	0	0	1	0	1	0	0
Municipal	0	0	1	0	1	1	1	1	1	0	0
PrivSec	1	0	0	0	0	0	0	1	0	0	0

Minfo	1	0	1	0	1	0	1	1	1	0	0
MOFihsA	0	1	0	0	1	0	0	0	0	0	0
g											
OilMinr	0	0	0	0	0	0	1	1	0	0	0

The data has been entered into Network X, a network analysis software developed by Aric Hagberg, Pieter Swart, and Dan Schult. Figures 23 and 24, show the visual representation of interaction among 19 organisations representing Oman's risk reduction network based on data provided by interviewees. Using social network analysis, the researcher was able to map out coordination between risk reduction organisations in the Omani DMS. The network represents a pattern of inter-organisational coordination and relationships between the actors during the risk reduction phase.

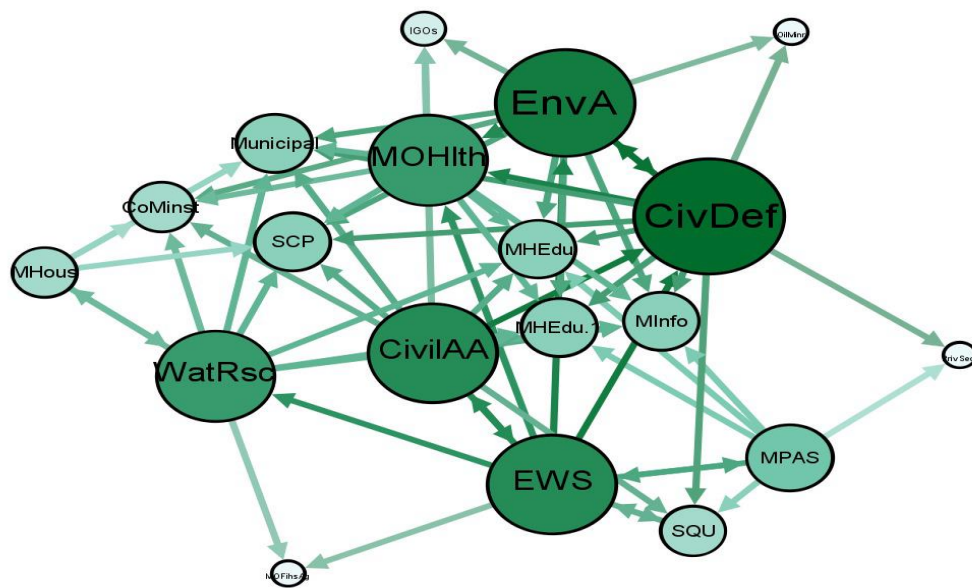


Figure 23: Graphical representation of the Omani Risk Reduction Network (Hagberg et al. 2008)

connected. The overall degree of centralization is 15.4%. The degree of centralization value indicates that many organisations were not communicating with other organisations. This implies that power and influence are distributed evenly across the network. This could mean that the risk reduction network is fragmented and does not have key central organisations that could facilitate coordination in the network. This lack of interaction denotes a major discrepancy from the stated national disaster management policies.

7.5.3 Risk Reduction Network Centrality Measures

Analysing network centrality measures helps identify the response network’s leading actors. Table 19 below shows the top 5 organisations in the risk reduction network, ranked according to their importance on centrality values, namely, degree, betweenness, closeness, and eigenvector. A degree of centrality analysis shows that organisations should interact more with other organisations in the risk reduction network. The total degree of centrality calculated by Network X shows that the Civil Defence Authority has the highest degree of centrality and can be regarded as the most influential in the risk reduction network.

From the figure displaying the networks graphic above, attention is focused on the degree of centrality. It shows that the Civil Defence node has a bigger size than other nodes in the network, and most of the nodes in this network depend on that central node. Therefore, Civil Defence is the dominant lead or administrative organisation in the risk reduction phase, not the NEMC or the Early Warning Sector as prescribed in the National Emergency Management Plan.

Table 19: Top five organisations under different centrality measures in the Risk Reduction Network (Hagbarg et al. 2018)

Total Degree Centrality	Out-Degree Centrality
CivDef	CivilAA
EnvA	EnvA
EWS	CivDef
CivilAA	EWS
WatRsc	WatRsc
In degree Centrality	Betweenness Centrality
SCP	EWS
MHEdu	CivDef

MEdu.	WatRsc
Municipal	SQU
MInfo	EnvA
Closeness Centrality	Eigenvector Centrality
MHEdu	MHEdu
MEdu.	MEdu.
MInfo	MInfo
SCP	SCP
Municipal	Municipal

Organisations with high out-degree centrality scores (represents the number of links or connections emanating **from** a node) include the Civil Aviation Authority (CivilAA), Public Authority for Environment (EnvA), Civil Defence (CivDef), Early Warning Sector (EWS), and Department of Water Resources (WatRsc). This confirms earlier findings that risk reduction responsibilities are scattered among risk-owner organisations.

In-degree centrality depicts the number of links directed **to** a node or the number of connections the node of interest receives from other nodes. In the Omani risk reduction network, the top organisations in terms of degree centrality include the Supreme Council for Planning (SCP), the Ministry of Higher Education (MHEdu), the Ministry of Education (MEdu), the Municipality, and Ministry of Information (MInfo). This confirms earlier findings that it is the SCP that approves and finances risk-reduction projects in Oman. Too, this confirms that the Media and Public awareness Sector is not active in the risk reduction phase as risk owner organisations and/or nodes with high outdegree centrality scores) seek support directly/bilaterally from education and public awareness organisations in Oman i.e. Ministry of Education, the Ministry of Higher Education, and the Ministry of Information.

Regarding betweenness centrality (measures the extent to which a particular node lies between the various other nodes of the network), the top organisations are the Early Warning Sector (EWS), Civil Defence (CivDef), Department of Water Resources (WatRsc), Sultan Qaboos University (SQU), and the Environment Authority (EnvA). It is the shortest path between other nodes, these organisations serve as gatekeepers between organisations and control the flow of information and resources in the network. This confirms findings from the interviews discussed in previous sections; coordination is not done through the EWS. Instead, there are other

organisations that coordinate among members of the risk reduction network. Meaning that EWS is not the central coordinating body in the risk reduction network.

Figure 25 below shows the brokers of the network. In the diagram, darker tones mean higher importance in this regard. As expected, the Civil Aviation Authority (CivilAA), the Department of Water Resources (WatRsc), the Ministry of Health (MOHth), and the Environment Authority (EnvA) are the most important nodes with respect to network cohesion. This confirms with interview findings that risk reduction networks are maintained independently (from the NCEM) by risk owner organisations.

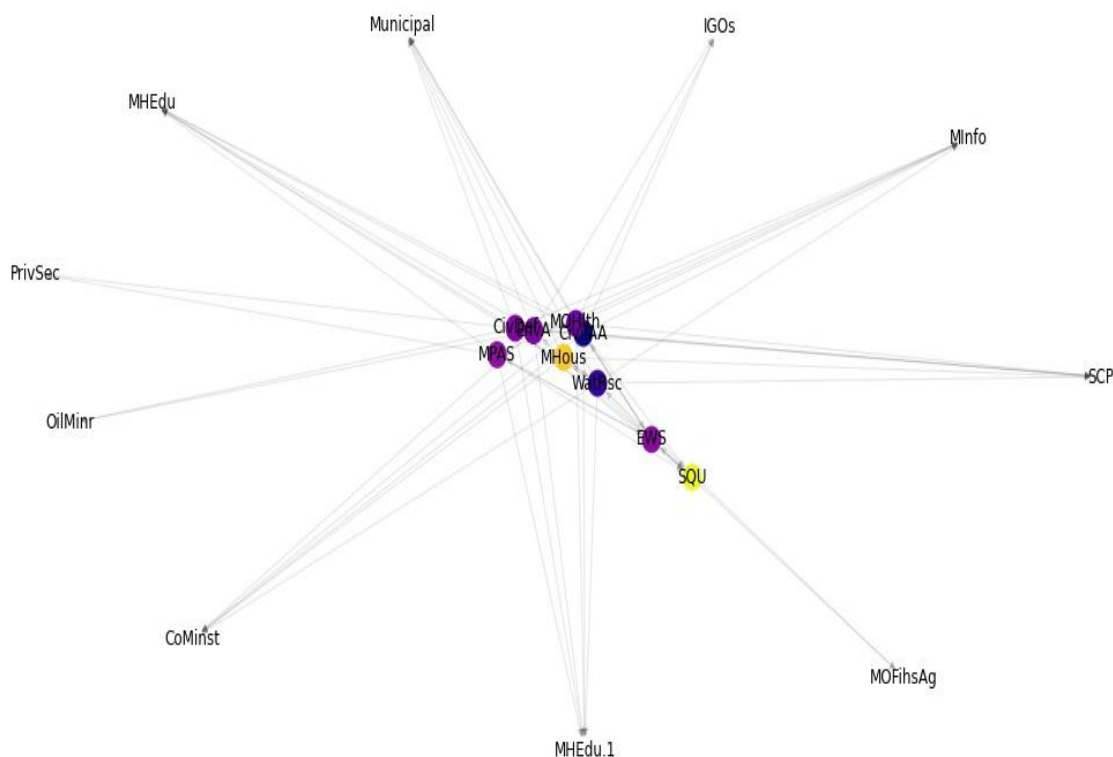


Figure 25: Brokers of the Risk Reduction Network (Bastian et al. 2009)

7.6 Risk Reduction Network Vs. Emergency Management System Network

Moreover, Figures 26 and 27 below, visually prove the significant change in the number and members, demonstrating a radical difference between the risk reduction network and the emergency management system network (EMS) as prescribed in the National Emergency Management Plan (NEMP). In particular, the Risk Reduction network nodes are way fewer than in the EMS network. It shows another relevant difference concerning centrality scores. For example, in the Emergency Management System Network, the National Emergency

Management Centre (NEMC) appears to be the most central according to most criteria. According to the risk reduction network, other organisations like the Civil Defence Authority (CivDef), the Civil Aviation Authority (CivilAA), and the Department of Water Resources (WatRsc) are the most important in various attributes. The difference is reflected in the individuation of brokers in both networks. In the EMS network, NEMC is the most important node in keeping the network connected, while the Civil Aviation Authority (CivilAA), the Department of Water Resources (WatRsc), the Ministry of Health (MOHlth), and the Environment Authority (EnvA) emerge in the risk reduction network.

However, many nodes have a high degree of centralities in the risk reduction network, meaning the lack of a central coordinator or leader organisation. As a result, neither the NEMC nor another specific influential organisation is available in this network to control and coordinate its activities. Most interviewees corroborated this fact.

For a better reach and flow of information in the risk reduction network, centralisation should be improved by having a central actor. For instance, NEMC or any other organisation coordinates risk reduction activities, manages information flow, and facilitates resource sharing among its member organisations.

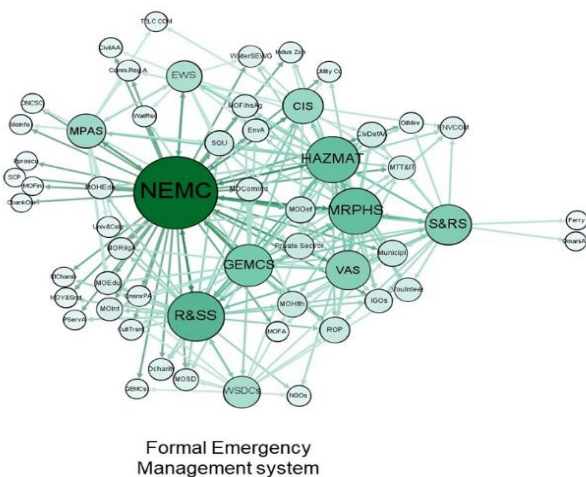


Figure 27: Formal emergency management plan (Hagberg et al. 2008)

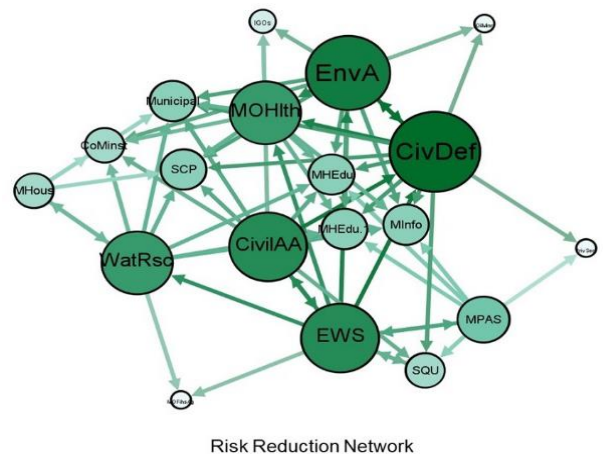


Figure 26: Risk reduction network (Hagberg et al. 2008)

Likewise, Table 20 shows a comparison between the Emergency Management System Network and the Risk Reduction Network in Oman.

Table 20: Comparison between EMS Network and Risk Reduction Network (Author 2022)

	Formal EMS	Risk Reduction Network
Total Degree Centrality	NEMC, R&SS, MRPHS, HAZMAT, GEMCS	CivDef, EnvA, EWS, CivilAA, WatRsc
Density	The network density is 0.07 showing sparse connectedness.	The network density is 0.187 showing sparse connectedness.
Centralization	The overall degree of centralization is 9.3%. The percentage indicates that many organisations were not in communication with other organisations. NEMC node has a bigger size compared to others.	The overall degree of centralization is 15.4%. It indicates several organisations were not in communication with other organisations. The Civil Defence node has a bigger size compared
Degree of connectedness	0.48. (A connectedness score of 1 suggests that all actors are reachable to each other, and a deviation from 1 indicates the fragmentation of the network).	0.71 (A connectedness score of 1 suggests that all actors are reachable to each other, and deviation from 1 indicates the fragmentation of the network)

7.7 Conclusion on Disaster Risk Reduction Network

The conceptual framework developed in this research was used to assess intersectoral coordination in the Oman post-2012 Risk Reduction Network. The risk reduction network was assessed using three dimensions: network governance, network coordination and collaborative functions, and network structure and characteristics. Social network Analysis (SNA) was used to assess the effectiveness of coordination and to map out Oman’s risk reduction network. The

researcher utilised collected data from the interviews to analyse network structure and identify relationship patterns with the network.

Findings indicate that While Omani Civil Defence Law and the National Emergency Management Plan mandate the National Committee for Emergency Management (NCEM) as the designated command-and-control organisation responsible for achieving risk reduction targets across sectors, governorates, ministries, and other organisations, NDMS member organisations often work independently or bilaterally/multilaterally to achieve the risk reduction objective.

All interviewees (n=48) agreed that the roles and responsibilities assigned to RR are well stated in the NEMP. However, they are not coordinated under the NDMS umbrella similar to those in the response phase. Hence, there is a consensus view among the 48 participants that NCEM is not doing as well in RR as it does in response. Furthermore, all the participants further posited that the Early Warning Sector, tasked with RR-related issues, has not been active enough to move the process forward.

In further proof of their claim, all the participants in the semi-structured interviews opined that the performance of NCEM in the coordination process across the phases of disaster management and sectors, Governorates and Wilayat has not been uniform. For example, one of the interviewees, a medical practitioner and top disaster manager in a public health authority, states that while NCEM leads Oman's entire emergency management efforts, the emphasis is on preparedness, response, and recovery operations (S14, 2022). Another interviewee reaffirmed this view in the following statement:

“I think the disaster reduction objectives, along with the roles and responsibilities identified in the NEMP in the RR phase should be implemented and followed by the NEMC just like the preparedness and response phase. Although the NCEM is mandated with RR issues just like preparedness and response, however, the RR phase does not get as much attention as response issues, nor are RR issues raised and discussed in NCEM meetings or Coordinator's meetings. Too, RR issues should be raised, discussed, debated, planned for, and coordinated at the Governorate EM Committees. I think most people believe that the NCEM is a response-oriented organisation” (S27,2022).

The research highlights some weaknesses in Oman's risk reduction and mitigation management system. Unlike the response phase, risk reduction is **not** well-coordinated and developed as expected. The multi-sectoral approach to risk reduction, enshrined in the National Emergency

Management Plan (NEMP), is deemed ideal for Oman, but only if the sectoral concept is practiced in risk reduction as it is already well practiced in the response phase. Coordination mechanisms for RR in Oman have weaknesses, with each ministry conducting its RR projects independently without a common platform for effective coordination. Key Performance Indicators (KPIs) mentioned in the NEMP lack detailed identification and monitoring for appropriate performance measurements. The lack of a unified strategic framework for risk reduction and coordination challenges with diverse organisations poses significant hurdles. While theoretical risk reduction considerations have resulted in policy documents, the practical implementation of RR in Oman remains traditional, with agencies working independently. The NCEM, although mandated to identify risk reduction measures and ensure national readiness for emergencies, fails to lead an effective risk reduction network. The risk reduction network does not receive the same positive reputation and public support as the response network.

Overall, the research emphasizes the need for stronger coordination and a unified strategic framework for risk reduction in Oman. It highlights the importance of sharing resources and information to achieve effective mitigation measures, better public awareness programs, and more resilient communities. Addressing these weaknesses and challenges can significantly enhance Oman's risk reduction and mitigation system.

Chapter 8 Discussion of Findings and Results

8.1 Response Network Vs Risk Reduction Network

The discussion in this chapter is based on the findings and results from the research study conducted on the Omani Disaster Management System. Findings from this study indicate that the Government of Oman recognises the obligation of the State to protect property and the environment. At the same time, it guarantees all citizens' right to live in the face of threats posed by natural and human-made hazards to the country. Further document analysis indicates that Oman is a signatory to several international laws and conventions and a member of many international protocols and global agencies on disaster management. Therefore, its national framework on disaster is designed to align with international standards, particularly the Hyogo Framework for Action (HFA) and the Sendai Framework for Disaster Risk Reduction (SFDRR). These leading frameworks consider disaster management to comprise four phases, namely: Mitigation, Preparedness, Response, and Recovery. Actions and initiatives in the first two phases form the subject of Risk Reduction. In reality, these phases have overlapping areas for implementing policies and action plans. Hence, the Government of Oman adopted an all-hazards approach to disaster management.

An underlying assumption in disaster management is that the response's effectiveness depends on the quality of risk reduction plans (McLoughlin 1985). It suggests that response and risk reduction activities are correlated and must be closely aligned. The effectiveness of a national response to any spatial or temporal hazard that leads to an emergency and consequently to a disaster can be assured only if authorities and partner agencies design and put in place risk reduction measures before a disaster occurs. Moreover, some differences exist between risk reduction efforts and response activities. However, disaster management systems can be conveniently dichotomised as Response and Risk Reduction. The policy in Oman is to have an integrated system with a single overarching organisation, such as the National Committee for Emergency Management (NCEM), to oversee the country's emergency management system (EMS). In contrast, findings from this study suggest that the preferable strategy for disaster management in Oman is the dichotomy but with the NCEM as the lead organisation in the two phases. Therefore, this chapter identifies the similarities and differences between Response and Risk Reduction Networks. The two components are the leading networks to analyse Oman's disaster management system in phases. Furthermore, the criteria used to assess the two networks were categorised under three distinct factors: governance, coordination functions, and

network characteristics. In the first category, the comparison is concerned with the legitimacy and organisational set-up, network accountability, and network leadership. while the second is about the coordination structure and practices that are planned or implemented. The third category focuses on determining network attributes using social network analysis (SNA).

However, the indication from findings shows that there is a consensual connection between Response and RR networks regarding disaster management based on Structural Complexity concerning the implementation of the strategic framework and objectives of the Omani emergency management system plans from national to governorate levels. Additionally, findings in the research indicate that efforts, whether in the RR phase or Response, are consistent in their approach to achieving the national strategic objectives of disaster management in Oman. Practically, both are complementary in achieving the goal of national resilience to disaster.

The strategic objectives of the Omani response are:

An effective response to emergencies and disasters by:

1. Effective and swift response operations.
2. Continuity of critical services and utilities.
3. Prompt recovery and rehabilitation of affected communities.

In contrast, the strategic objectives for risk reduction in Oman are:

1. To Adopt risk reduction as the basis of disaster management.
2. To develop and enhance early warning capabilities.
3. To improve public awareness and enhance community resilience.
4. Enhancement of organisational/business and community resilience.

8.2 Governance

The current research established a solid institutional basis for implementing plans in both phases to achieve the strategic objectives. However, the government places priority on the development of policies and legal instruments. Notable is the fact that although responsibilities and capacities are decentralised at the three levels of government administration, leadership and coordination are provided from one focal point, namely the NCEM. However, it should be noted that only two levels are currently fully operational; the Wilayat level is not yet fully

implemented. The policies contain measures directed at mitigating risks and reducing the impact of hazards, along with preparing for effective response and relief operations. The measures are, on most occasions, cross-cutting and transcending the phases of disaster. In other words, the measures are sometimes equally relevant and applicable both in risk reduction and response phases, even though almost all interviewees agreed that risk reduction is weaker than response.

There is a consolidated national policy and legal framework in place, which comprises stipulations, relevant in both phases of disaster. In addition, planning and implementation in both Risk Reduction (RR) and Response are guided by the same legal framework because the Government's approach to legislation is that of a holistic view of disaster management. Thus, two acts apply in the RR and Response phases: The State of Emergency Law (Royal Decree 75/08) and the Royal Decree (5/2020). The disaster management policy in Oman uses risk management methodologies that blend with traditional disaster management approaches and risk management concepts founded on principles developed in the HFA and SFDRR. According to some interviewees, the Oman disaster management principles include a decision-making process that provides a common language among all participating organisations. This facilitates coordination and integration, providing a means of ordering and prioritising activities related to disaster management. In other words, there are similarities in the processes of formulating policies and action plans, both in the RR and Response phases. However, RR is done more independently and with much less coordination. In contrast, Response coordination, led by the NCEM, is much more intensive.

Moreover, findings from interviews conducted indicate that the national strategic objective is to recognise the connection between RR and Response. Disaster management priorities include establishing early warning systems, promoting risk assessments and risk reduction research, training and capacity building, and maintenance of inter-sectoral coordination mechanisms to ensure an immediate and effective response to emergencies and disasters. Thus, the NCEM is primarily responsible for developing and maintaining an integrated disaster management system that includes both RR and Response across the board, both in temporal and spatial dimensions.

Activities falling under response include activation of emergency plans and operation centres, keeping the public informed, search and rescue, evacuation, and relief operations. As part of the Response or RR, the activity extension follows the strategic objectives adopted in each

phase. For instance, activities that fall into preparedness and response include the development of emergency operations plans, establishing emergency operation centres, and maintaining effective communication with the public and among all participating agencies and organisations.

8.3 Organisational Structure

A unified, multi-level, function-based emergency management structure works for RR and Response. However, all sectors are encouraged to be actively involved in both phases. On the contrary, not all sectors are actively involved in RR, like the Relief and Shelter (R&S) sector, and the same applies to the response. Moreover, some sectors designated to respond in times of emergencies are known as ‘response-oriented sectors.’ Examples of response-oriented sectors include Search and Rescue (S&R) and Victims Affairs. Findings from the interviewees show that lessons learned in response to previous major emergencies have highlighted the need for a reduced number of decision-making nodes for response operations to facilitate an organised response and avoid complications in coordination. It does not mean other sectors are entirely excluded from contributing, instead, they are a means of achieving synergies when needed most.

The similarity between RR and Response is that both use a bottom-up approach, starting from the lowest level of government administration. For example, the local level (Wilayat) climbs the ladder to the governorate and national levels in control of every assigned responsibility for RR and Response activities at different phases. In the case of mitigation and preparedness, the responsibility includes strengthening and supporting initiatives emerging from the Wilayat level and encouraging people to take active roles in planning and implementing RR community measures. In the case of response, first responders are often from the affected communities. The frontline responders are often involved in life-saving measures such as evacuation to higher grounds and provision of on-site medical assistance. However, due to limited technical support, resources, knowledge, and skills, first responders and communities have no choice but to seek assistance from higher levels of government.

Another shared feature of the ODMS structure is that the National Emergency Management Centre (NCEM) functions as an emergency operation centre at the national level and serves as a secretariat, as well as a tool for monitoring the goals and objectives in the coordination of Response activities. However, the NEMC has not been active in carrying out risk reduction

and coordination tasks. The establishment of the Emergency Management Committees in the governorates (GEMCs) was to ensure the implementation of RR and Response activities in each governorate. As earlier discussed in this research, the GEMCs structure and mandates reflect the National Committee for Emergency Management (NCEM) goals and objectives. It is an extended channel for implementing RR and Response in the governorates. They achieve their aims and objectives by mobilising and directing the resources and capabilities of relevant sectors and various other leading agencies operating in the governorate, even though they have not been active in RR.

The approach to implementing RR measures is different from that of response in terms of mobilisation of resources and capabilities. For example, further findings from the interview show that a GEMC activates its response plan during an emergency. It deploys the incident management teams and mobilises S & R teams, and the medical response teams. At the same time, it ensures the provision of shelter and relief operations, restores utilities and critical infrastructure and assists victims. In addition, the GEMCs manage volunteers and donations and coordinate support and mutual aid within the governorate and with neighbouring governorates. These tasks are designated as the responsibility of the NCEM and its branches in the governorates. In contrast, it is not the NCEM but the Cabinet Office that reviews, assesses, and funds large-scale disaster reduction projects involving complex structural RR measures like building dams, and constructing rain drainage systems, roads, and flood tunnels.

However, the means for achieving response are relatively defined, but those of RR remain uncertain. For instance, interview findings indicate that most of the WSDCs are not yet functioning as expected, jeopardising accountability. Although better established than RR, there are still some weaknesses in response. Some interviewees pointed to the centralisation of power and bureaucracy in the NCEM as probable factors affecting response accountability. Others identified a lack of dedicated coordination units in almost all the sectors, low levels of public awareness, unequal participation in decision-making, and poor communication equipment as factors that affect accountability in Response.

8.4 Accountability

The sectors' unilaterally, bilaterally, or multilaterally action relating to accountability is a significant concern. Notably, the use of funds for projects All projects, whether response or RR, require adequate funding. Generally, the process of funding in ODMS is according to an

established top-down hierarchy, except for structural projects, which are primarily associated with RR. Interview findings show that future disbursement of funds directly from the Ministry of Finance to relevant public agencies should follow the RR needs to be established in the annual budget plans of the organisation after approval is obtained from the Super Council for Planning (SCP). Document analysis indicates that this deviation in the established process of funding in the NCEM may be an attempt to address accountability issues. The Humanitarian Accountability Partnership defines accountability as ‘the means through which power is used responsibly’ to ensure objectives are met (Humanitarian Accountability Partnership, 2010). Therefore, accountability in disaster management is a process in which the needs and views of all stakeholders are taken into account in RR and Response activities.

Accountability is a vital part of good governance and is reflected in the organisational structure and strategic framework. In comparing accountability in RR with that in Response in Oman, it must be borne in mind that there is a legal framework built around the two Acts mentioned in the preceding chapter 5 (sections 2 and 3) of this study. The interview findings indicate that the policies and plans have been formulated, based on the two Acts, to ensure accountability, cooperation, and participation of partner agencies as well as communities at risk or are affected. They have the distinct objective of promoting good governance and accountability to stakeholders in the ODMS. However, the methods of using power to achieve RR and Response strategic objectives, namely policies and plans, have been mentioned in (section 8.1). Thus, the degree of accountability achieved in the Response phase in Oman may differ from the ones in the RR phase. In the case of Response, the NEMP lays out hazard-specific response strategies in a system spearheaded by NCEM, whereas the rest of the document lays out agency-based functions for RR.

Document analysis shows that although the Government of Oman accepts that the State has the primary role in RR, the responsibility needs to be shared with other stakeholders such as local governments, the private sector, and civil society for the participation of affected communities to be enhanced. Noting that national policies and plans originate from NCEM, some interviewees believe that it is important, therefore, that NCEM reforms the strategies and operational mechanisms that ensure increased accountability and participation of all private and public sector organisations in RR.

8.4.1 Policy and Plans

NEMP serves as guidance for the NCEM in policy formulation, planning, and implementation of plans. Thus, 90% of interviewees (n=43) believe the directives in the NEMP for the implementation in both DRR and Response are similar in approach. The approach in the NEMP is to view inter-sectoral coordination and collaboration with NGOs and private sectors in both RR and Response as the essential foundation for building an effective disaster management system in Oman.

Also, 70% of the interviewees (n=33) criticised the NEMP as focusing more on response than RR which analyses and guides the national disaster management framework on contemporary issues in disaster response. It emphasises response operations and establishes appropriate coordination mechanisms that include a functional command system for managing disasters. Document analysis indicates that for Response, the critical task of NEMP is to direct the development of emergency response plans (ERP) and SOPs. Beyond this task, the ERPs and SOPs provide details for coordinating the emergency response activities of NGOs, private sector corporations, and international humanitarian organisations in all kinds of emergencies. The ERPs are designed for contingency plans, which help identify the material resources and the types of expertise required in Response.

In regards to planning for response, NEMC is responsible for developing contingency plans by collecting, processing, and evaluating situational incident information obtained in the risk analysis process. Such incident action plans specify how response operations proceed. However, the common objectives in all plans, whether in the NEMP or ERP, are effective responses during emergencies. In addition, Response plans are all about achieving integration between the components of the ODMS, including following up efforts to improve the national capacities and capabilities required for achieving desired effects. Also, it ensures the organising and integration of response efforts and resources. However, as it has turned out, unlike response plans, there are no risk reduction plans or programs that are implemented by the NCEM to achieve risk reduction objectives identified in the NEMP. Thus, the issue is why the NCEM, which has displayed good capabilities in response, is not being used to achieve risk reduction as risk reduction efforts are scattered among concerned ministries.

Further findings in the document analysis indicate that risk reduction aspects identified in the NEMP are merely guiding principles for participating agencies. They focus mainly on

secondary mitigation measures or structural mitigation measures, such as those executed immediately before a flood. However, the plans in Response provide rules, regulations, and guidance for response and also define the organisational structures for achieving a coordinated response. The NEMP explained how resources and information are shared during Response. However, NEMP guidance for resource and information sharing in risk reduction does not exist.

Both interviews and document analyses in this research underline the significance of the Royal Decrees, which regulate ministries. According to one of the National Coordinators, RR projects are classified as either complex (structural) or soft (non-structural) projects. The RR structural projects are considered as part of national development projects under the supervision of the Cabinet Office and SPC. Although NCEM is the command-and-control organisation of the NDMS, the Public Authority for Environment (MECA) is in charge of developing Oman's annual risk reduction report., it is the Supreme Council for Planning (SCP) that ensures the inclusion of RR projects in the national development plans and it ensures that such projects are in accordance with SPC's Urban Planning Standards and the National Spatial Strategy. Thus, in contrast to Response, the implementation of RR projects is devolved to technically capable line ministries. For instance, the MOH handles health-related risk reduction projects/programs, and the Ministry of Municipalities and Water Resources handles the development of flood risk mitigation/reduction measures.

Oman's National Development Plan provides for substantial structural mitigation measures. However, the effectiveness of the structural risk mitigation measures in the National Development Plan depends on its emergency response systems. It ensures early warning is received, communicated to the right people, and acted upon with adequate knowledge and capacity to save lives and protect property. Therein lies the rationale for linking RR and Response's national and governorate systems as RR and Response's policy planning tools are interconnected. They rely on EWS, contingency planning, risk-proof investments, eco-system management, and social networks, although their planning processes differ.

There was a consensus agreement among 85% of the interviewees (n=40) on the need for interactions between organisations on shared responsibilities on aspects related to risk reduction and response to achieve integration and allow disaster management operations to run efficiently and effectively.

When asked whether there are differences in the preparation and execution of plans by sectors and agencies as they work with the NCEM, a senior official in the NEMC replied:

“There is a marked difference in the type of roles and responsibilities and type of mechanisms for achieving objectives in risk reduction as compared to response. In response, we deal mainly with a handful of sectors, but work directly with many ministries with risk reduction issues.” (A2,202)

He further noted that the critical function in Response at all levels of administration is incident management. This is because the primary goal in Response is saving lives and livelihoods. Other interviewees noted that incident management in ODMS comprises all command-and-control activities aimed at preparing and executing plans and directives concerned with responding and recovering from the effects of a hazard. Further study findings from all interviewees (n=48) indicate that the Response system in Oman is functionally oriented and varies in complexity at all levels of government, depending on the emerging situation. All interviewees agreed with the suggestion that the Response system involves cooperation and collaboration of multiple organisations and disciplines acting across different jurisdictions.

The research findings also from documents analysed and interviews conducted show that while the Response system in Oman has unambiguous formal reporting relationships and clear lines of supervisory authority, it incorporates a team-based leadership approach. Interviews show that this team-based approach allows officials from different organisations with different responsibilities to provide on-scene direction and management for the common good of the Response system. On the other hand, the RR system is more aligned with an autonomous arrangement. It allows public and private sector organisations to act independently or collectively to achieve set objectives for their institutions.

The sectors of the Omani DMS have one thing in common in the response phase. Interviewees admit a strong field leadership base representing the essential response system component. This characteristic appears to be weak in the RR system. The leadership in response has previously proven to be effective in guiding field response activities such as search and rescue, medical response, relief and shelter, hazardous materials, victim’s affairs, and utilities in the integration of efforts to use resources and capabilities optimally and share information efficiently and effectively.

8.5 Coordination Functions

8.5.1 Intersectoral Coordination

The communication of risk information and knowledge sharing to assist in effective Response are essential components for preparedness and protection. Both RR and Response require effective plans for the two-way transmission of data and information between the public and disaster management authorities. The preceding sections of this study point to using a common end-to-end system in Response to activities in Oman, known as the Joint Media Centre (JMC). The JMC is activated only during Response. Although the MPAS is mandated to coordinate risk information awareness activities during RR, the sector has been ineffective during the phase. Risk information is left to each ministry, and ministries connect directly with the media and the education system. Thus, there is an apparent weakness in coordinating communication and public awareness activities in the RR phase. Common mechanisms in use in the JMC include radio and television broadcasts, print media, internet and social media, and social networks. The JMC is linked in both cases to the NCEM, Governorates, Sectors, Wilayats, NGOs, global partners, and all other leading responding agencies. In addition, the JMC is designated as the only official source of information in Response. Therefore, the communication mechanisms are the key instruments for effective coordination in both phases. Findings from among those interviewed, 70% of the interviewees (n=33) opined that information sharing in Response is well managed.

Consequently, comparing coordination in Response and RR is best achieved by looking into who does what, how, and when. It is also important to discuss the challenges encountered in both phases. According to some of the senior managers interviewed, effective coordination would result in increased accountability. However, they also stated that coordination must be built on cooperation and collaboration among all partners in the disaster management system. Coordination brings together the main actors at the national, governorate, and Wilayat levels for a common purpose. The key to achieving successful coordination in response is information management. According to the World Health Organisation (WHO 2020), a well-coordinated humanitarian response system facilitates the transition from relief to recovery and makes humanitarian assistance more efficient and effective. However, findings from interviews conducted show that 85% of the interviewees (n=40) agreed that there is a well-established response information management system for the NEMC to share information effectively to

the sectors at the national level, public agencies in Governorates and Wilayats, and focal points in other agencies (vertical information sharing).

Coordination at the governorate and sector levels also follows the same pattern, in this case for horizontal information sharing. However, there is the additional function of assessing the impact on the local areas. Challenges associated with this function are more pronounced in Response than RR because, in Response, there are often conflicting reports about the extent of damages within communities. Thus, coordination in response requires additional efforts to define the affected population and determine the actual needs of the affected communities. Moreover, the timing of information is as important as its completeness and accuracy since quick decisions are needed to save lives and property.

Findings from both documents and interview analyses in this research reveal that the government of Oman views coordination as a tool to promote the efficient use of scarce resources. The aim of coordination in both response and RR phases is to minimise duplication of efforts, enabling complementarity in managing RR and Response. In addition, this research showed that the prime objective of Oman's inter-sectoral coordination plan is to ensure functional and sustainable mechanisms for delivering relief to affected communities and reducing disaster risk by following the standards in international protocols. WHO (2020) states that successful coordination implies context-specific, demand-driven, and timely interventions with incentives for principled humanitarian action.

Additionally, findings from 70% of the interviewees (n=33) argued that coordination and collaboration during response are more intensive than RR. Coordination in response in Oman is based on pre-tested advance plans that are contained in the NEMP, GEMP, Sector Plans, and ERPs of responding agencies. It includes several activities such as resource management, information sharing, volunteer coordination, supply management, and transportation that must be integrated as the emergency unfolds. These are not applicable in RR-related projects because they are longer term in nature and, secondarily since RR coordination functions are distributed among several organisations.

A senior official of the MR & PH sector posited that coordination in response is a paradox that poses challenges to coordinators. On the one hand, it requires careful planning and organisation, but on the other hand, it happens spontaneously. Besides, all interviewees (n=48) reiterated that the sectors had garnered experiences from cyclones that hit Oman in recent years. It indicates that, in response, coordinators need to improvise, adapt, and innovate during

emergencies. However, the situation is different for coordinators in coordinating RR projects because they have adequate time to plan, review plans, and test their models.

In response, coordination and information sharing starting from the early stages of a disaster (forecast phase), leading to the recovery and demobilisation phase. It is the responsibility of NEMC to coordinate response and information sharing among various agencies at the onset of an emergency. Moreover, this study shows that NEMC aims to achieve quick restoration and minimal loss of lives and property as multiple agencies are deployed to provide relief materials to affected communities. Therefore, the NCEM works with all responding agencies to prepare contingency plans before the occurrence of an emergency.

The NCEM is proactive in Response but relatively dormant in designing and implementing RR measures because most RR activities have been devolved to line ministries and other lead agencies. It implies coordination is more intensive in response than RR. The primary function of National Coordinators of all responding sectors is to advise the Commanding Officer at the NEMC and execute operational coordination and mobilisation of resources to save lives and minimise material losses on behalf of their respective sector authorities. According to some senior officials of EWS, MR&PH, and RSS sectors, coordination of activities in response requires a more participatory process than in RR. Response plans emphasise coordination at the Governorate and Wilayat levels because the Wilayat level is not fully activated. Most coordination and commanding efforts are made through the GEMC. However, it is an apparent weakness in the response system as it is not wholly practised locally. Interviewees noted this as a grave concern because the GEMCs and WSDCs are expected to play significant roles in coordinating local response to disasters. Therefore, a critical issue raised in Oman response management is whether the NCEM has successfully promoted vertical and horizontal integration among the different participating organisations.

Consequently, one of the NEMC senior officials stated that obeying government laid down hierarchies is significant to emergency response (A5,2022). It is necessary to draw upon a wide range of resources and capabilities of the private sector, civil society, humanitarian organisations, and international and local communities. Effective coordination and integration are achieved through a cluster system in which responding organisations are designated main or supporting entities. The main entities are further classified into three categories, emergency response entities concerned with protecting lives and reducing human casualties; entities concerned with limiting the impacts of emergencies on affected people. Furthermore, entities

responsible for limiting the impacts of the emergency on infrastructure and utility services in the affected areas.

Achieving vertical and horizontal integration through coordination is another challenge for coordinators in RR and response. However, RR integration differs from the emergency response case since RR efforts include more permanent objectives requiring fixed organisational structures. In response, the use of ad hoc relief organisations and networks created in the communities is often an efficient and effective means of achieving the key objectives of responding to the needs of affected communities. Interview findings show that temporary or “emerging” collaborative networks are a fundamental component of the emergency response in Oman, while RR objectives are achieved in a more rigid but decentralised manner. The issue of decentralisation of RR activities raised concerns among interviewees. For instance, one of the sectors’ coordinators made the following remarks:

“There is a noticeable difference between coordination in response and RR. There is effective nationwide coordination in response. The same thing cannot be said of RR because there is no hub to act the way NCEM does in response. As a result, NCEM’s role in risk reduction is minimal.” (S10,2022)

The official criticised the decentralisation of responsibilities in the Oman RR system, describing it as ineffective in achieving disaster risk reduction goals. After all, it presents a significant challenge to coordinators striving to achieve effective integration. According to the official, disaster risks can be traced back to social, economic, environmental, and political processes, which involve actors in government, civil society, and the private sector at different levels. Hence, a centralised system linking all actors under one coordinating organisation to further facilitate the integration of all sectors and players. A more permanent involvement of non-governmental organisations is desirable to build the capacities of urban and rural communities in responding to future emergencies and disasters.

Coordination in the RR network in Oman looks similar to that in other government departments. Government departments are often characterised by red-tapism and bureaucracy. In contrast, the task environment in response requires a flexible leadership approach to coordination (e. response coordinators need to move with speed and readiness between communities, coordinating disaster operations and facilitating cooperation and collaboration among responding organisations and communities when a major disaster strikes). Also, interview findings show that the effectiveness of coordination in response rests primarily on

the interpersonal skills of the coordinators. With RR, the coordinators rely more on their technical skills.

8.6 Sectors

This research study is based on the use of the Social Network theoretical framework to explore one of the study objectives which is the effectiveness of existing inter-sectoral coordination and coordination mechanisms within each sector and among all sectors recognised in the post-2010 Omani EM system. Findings from documents analysed and interviews conducted indicate that the sectors are clustered in the ODMS according to their function (a function-based categorisation). A comparative appraisal of the overall findings indicates that Oman has taken into consideration risk reduction needs in the post-2010 systems by underlining the following:

- Identify risk reduction goals, principles, roles, and responsibilities for each sector/agency (included in the NEMP).
- Designate two sectors to tackle and coordinate risk reduction phase activities, namely the EWS and the Media and Public Awareness Sector. The EWS is mandated to develop and update risk assessments, as well as coordinate risk reduction/mitigation measures among government departments. At the same time, to enhance coordination among various early warning centres that operate in Oman and work in synergy with various organisations in developing legal risk education and awareness material in collaboration with the MPAS. However, the reality is that none of these mandates is currently being implemented by the EWS.
- It allocates two significant roles to MPAS: one during the risk reduction phase and the other during the response phase. While MPAS has shown to be exceptionally adept during the response phase, it is almost inactive during risk reduction when it is supposed to work with the EWS in developing risk education materials.

Further interviews and document analysis show that the EWS is tasked with a complete risk reduction role that includes risk assessment, identifying risk mitigation measures, and enhancing early warning systems and public awareness. Although the EWS has not been proactive in its assigned tasks, information from the Interviewees revealed that the Meteorology Department is in charge of the EWS. It only provides predictions, forecasts, and other decision-making tools needed for effective Response immediately before a cyclone or storm hits. Unfortunately, the two sectors designed to carry out most of the planning and

coordination during the risk reduction phase on behalf of the NCEM are inactive in the risk reduction phase. Therefore, it reflects the overall performance of the Omani National Disaster Management System and indicates a weaker performance in RR compared to response.

8.6.1 Sector Performance

The Critical Infrastructure Sector (CIS), (medical Response & Public Health Sector) MR & PH, and HAZMAT Sector are examples of sectors that have turned out to be response sectors in outlook but with limited performance in risk reduction. The other three sectors Relief and Shelter (RSS), Search and Rescue Sector, and Victim Affairs Sector (VA), are entirely response sectors in operation.

8.6.2 Critical Infrastructure Sector

A senior official of CIS posited that infrastructure resilience in Oman has proved to be a complex problem on several fronts because all critical infrastructure utilities and services are interrelated. A problem with any of them can impact many other utilities and services. This makes coordination in the CIS a ‘system of systems’ comprising functions related to energy, water, healthcare, transportation, communications, and many more. It is noted that each system reacts with the other in different ways. Since each sector needs to be prepared for disasters, the collecting, collating, and maintenance of data on their collaboration becomes a top priority. Sometimes, things are more complicated than expected. The physical assets that make up each system may belong to different entities in different sectors, compounding coordination efforts both in RR and Response. For instance, the Public Water Authority manages water facilities. Also, the Electricity Regulation manages the power and electrical grid system. In these cases, such critical assets belong to private sector organisations.

In addition, the definition of critical infrastructure may change over time. For example, a seemingly unremarkable access road may suddenly become critical in an emergency. Thus, unlike response activities that are often one-time exercises, RR measures that tackle critical infrastructure resilience are processes over time and have asset-to-asset dependencies. The senior official further noted that the assets are managed independently during normalcy, implying diverse asset management processes. In times of national emergency, critical assets are often under higher levels of stress levels and are more likely to fail. The effective response depends on the capacity of each organisation to manage and maintain the assets. Therefore, the core function of the National Coordinator of the CIS in RR is to ensure critical infrastructure

systems are designed to be reliable against different threats and risks associated with all types of hazards. Unlike some other sectors, the CIS participates actively in all phases of disaster. In addition, its operations must comply with extra legislation such as Municipal bylaws and contractual Service Level Agreements (SLA) with the government.

Interviews emphasise the complexity involved in building sector-wide capacity to improve effectiveness. Documentary evidence indicates that the CIS conducts risk assessment meetings/workshops with participation from various member organisations. However, interview findings from 75% of the respondents (n=36) reveal that such gatherings are not as inclusive as on the scale of consultations that happen in response, and consultations on RR issues are often among a few sector stakeholders. Although practically, the national sector coordinator calls for strategic meetings that bring together all representatives of sector ministries, the gathering often pays more attention to response issues than RR. The meetings also use different frameworks and mechanisms for decision-making in RR and response. For example, formal mechanisms are used more in RR, while fewer formal mechanisms are preferred in response.

A senior official of CIS described the current relationship between various entities regarding disaster reduction as not as integrated and coordinated as response network relationships. Also, when asked if there is a difference in the kinds of coordination mechanisms used in disaster response compared to RR, the official replied:

“There is a noticeable difference between coordination in response and that of RR. The challenges in RR are related to issues such as significantly large budgets that require special approval from the government, the approach of ‘if it is not broken, do not fix it’, and the long-term effect (unseen outcome) of RR measures/projects. These factors make coordination happen in the traditional bureaucratic style, rather than the fast urgent response style of coordination.” (S24,2022)

This statement summarises the general view among interviewees that the CIS is more efficient in Response than RR.

8.6.3 Early Warning Sector

On the same note, findings from all interviewees (n=48) indicate that the EWS operates only at the national level but has early warning centres distributed across the country. However, they stressed that the EWS has the most contact with the NCEM during emergencies compared to other sectors. Regarding who does what and how? The EWS stands out as unique because

the results of the sector's risk analysis study represent the backbone of the National Disaster Management System in Oman, as well as form the basis for developing all plans, whether the NEMP, GEMP, sector plans, or main agency plans.

In addition, the EWS is one of the main actors in developing public awareness programs and provides data and technical advice to all other sectors in developing structural and non-structural measures to mitigate the effects of hazards. Furthermore, the sector cooperates with relevant urban planning and development entities to integrate RR objectives and measures into national development plans. However, interviews and document analysis show that most of the work of the EWS is considered non-structural disaster risk reduction activities and often does not involve developing or implementing large-scale risk reduction programs.

On the other hand, 90% of interviewees (n=43) indicate that Oman's early warning systems are built on a solid foundation, which requires a people-centered management approach. For people to understand the warnings, there must be adequate channels to transmit them to the appropriate beneficiaries. The target populations are completely different when dealing with the response and RR issues. The two populations can be classified as emergency responders and stakeholders, respectively. It is only by understanding the differences between the two populations that adequate response and reduced risks are achieved.

The EWS functions are critical in RR and response, but they are different in how the sector implements national and sectoral plans to achieve any stated objectives. A senior official in the EWS stated that the difference is not in which organisations the sector deals with but with whom they deal. A National Coordinator summed it up with the statement below:

“In risk reduction, we carry out activities such as risk analysis and compilation of risk mitigation measures with those who are in the risk reduction arena who tend to be technical people in the ministries mandated with dealing with certain types of risks in Oman. In the response phase, we deal with people who are less technically oriented but who oversee response in the sectors/agencies of the NDMS for media coverage and public information management.”(S12,2022)

However, this study analyses who does what in the initial two phases of the early warning systems concerning forecasting and monitoring. It is evident from the interviews that there are two trends a centralised system in which the NCEM is responsible for carrying out these

functions and a decentralised system where measures are developed and implemented by other agencies, including municipal workers and volunteers at the Governorate and Wilayat levels.

Consequently, a different technique is used to identify risk reduction/mitigation requirements. Interviews suggest that Ministries and Public Authorities within the EWS implement risk reduction projects either as an essential part of their annual budgets or as an execution of an order issued by His Majesty the Sultan through the Cabinet Office. For example, the National Multi-Hazard Early Warning System was implemented by the direct orders of the Sultan upon the destructive 2004 Indian Ocean Tsunami (S11, 2022).

However, there are times when a ministry does not get the budget needed to carry out certain risk mitigation projects. In such cases, a ministry would raise the issue at NCEM meetings to solicit support and recommendations from the NCEM. The NCEM submits such recommendations to the Super Council for Planning/Cabinet Office to enhance the prior requests made by that ministry. Also, there are instances when a concerned ministry faces challenges implementing certain risk reduction measures due to some uncooperative agencies. Thus, such an issue would also be raised and resolved at the NCEM meetings.

In contrast, response operations are implemented using established SOPs to provide forecasts and warnings and embark on public awareness activities. Although there is a strict vertical command and control system for member organisations of the sector, the National Coordinator of the EWS plays the additional role of coordinating the RR activities that involve multiple organisations outside the jurisdiction of the EWS. For example, there are SOPs to activate emergency response operations and public warning systems involving the NEM Centre, the National Early Warning Centre, the MPAS, and telecommunication companies during emergencies.

8.6.4 Media and Public Awareness Sector (MPAS)

The MPAS, chaired by the Ministry of Information, is mandated to provide effective media management and communication of warnings and instructions in RR and response. Although it uses the exact mechanisms to achieve its objectives, the tasks and systems involved in achieving the objective of media and public awareness in RR and Response are completely different. However, information retrieved from 70% of interviewees (n=33) indicates that the sector works at the national level only, with two primary functions, one in RR and the other in response. It was established in the preceding sections on a response that the main function of MPAS during disasters and major emergencies is to develop and execute a public information

plan and coordinate information management with public and private media organisations. Additionally, the role of MPAS in risk reduction is to coordinate the development of educational materials to create awareness of disaster risks Oman might face. These two functions are different, implying that the processes of making the public aware of issues are also different in RR and Response. Further information derived from interviews shows that the objectives of conducting public awareness activities in times of response to emergencies are short-term and as follows:

- Sensitise the public and responding authorities on the hazard's impact and provide feedback on the progress and effectiveness of response efforts.
- To keep the public informed and aware of the hazard dynamics and provide updated forecasts.
- To inform the public of response, rehabilitation, and recovery efforts.
- To inform appropriate authorities of any challenges faced by affected communities.

In contrast, the objectives in RR are relatively long-term and include:

- Collating risk reduction awareness materials and related educational materials are obtainable from the EWS, HAZMAT, and other technically oriented organisations such as the Ministry of Education and universities.
- Ensuring risk reduction awareness materials are published and disseminated to the public.
- Coordinating the development and implementation of risk awareness programs.

However, the Response phase is highly emphasised to ensure that the public information plan regarding the emerging situation is activated. The plan includes providing information and warnings to the public and to the JMC to retrieve and transmit necessary information to responding organisations. There is urgency involved at this stage, and it is often not possible to conduct meetings and training sessions. Instead, the JMC engages with public information officers and media cells in each GEMCs for public information and awareness activities. The Response phase involves the active participation of the GEMCs, who, at this stage, are mandated to collate and transmit information to and from participating agencies in the governorate. In the RR phase, risk awareness or risk reduction education is carried out independently, coordinating with the Ministry of Education and media organisations. It is not

done via the MPAS sector nor by WDSCs. Moreover, a collective and coordinated effort in education/awareness of risk does not exist for now, therefore, no common coordinating unit.

8.6.5 Medical Response and Public Health (MR & PH) Sector

The name ascribed to this sector shows that two different duties are fused into one sector, indicating that two distinct roles are expected from the sector. An analytical review of findings indicates that the Medical Response section is concerned with activities associated with emergency response, while the role of the Public Health section is to develop and implement the public health risk reduction strategy. In an emergency, MR & PH works in coordination with the healthcare system at all three levels of government administration.

However, all interviewees (n=48) in the interviews maintain that the approaches to response are different from those in RR. In almost every case of a major emergency, the MR & PH Sector is one of the first sectors to be called upon to respond. Hence, emphasis is placed on preparedness to respond to multi-casualty incidents and many other hazards that impact public health. As expected, the leading organisation in medical response is the MOH. It chairs the MR & PH Sector and works in close liaison with the armed forces medical services, police medical services, private sector medical services, and international organisations like the World Health Organisation (WHO) to provide medical response in times of emergency. Therefore, medical response is seen as an integral part of Oman's national response to emergencies. A representative of the MR & PH Sector stated:

“The MR&PH Sector works very much in coordination and collaboration with the NCEM and the NEM Centre. We are an active sector and an integral part of the disaster response system that the NCEM directs, coordinates, and leads.” (S11,2022)

Overall, it implies that the role of the sector coordinator, like any other sector, is to ensure the sector is ready to respond and submit to the leadership of NEMC during disasters or major emergencies. It also means that response resources are shared among various agencies within the national response system, in which MR & PH finds itself as just one of the sectors involved. However, the development and implementation of public health risk reduction strategies are done independently by another national committee that is designated to develop and implement public health risk reduction programs. Thus, MR & PH is not regarded as

part of NDMS concerning public health risk reduction activities. A senior official of the MR & PH Sector stated:

“We are a response-oriented sector and most of our interaction and coordination with the NEMC, other sectors, and agencies occurs during the response phase. Our encounter with other sectors and agencies is very minimal in risk reduction. In fact, the relationship almost does not exist in the RR phase.” (S12, 2022)

This scenario is similar in all other response-oriented sectors. More so, the Search and rescue Sector and HAZMAT Sector are side-lined in the RR phase. Just like the Ministry of Health’s role in developing public health risk reduction measures, it is the Public Authority for Civil Defence, which chairs the HAZMAT Sector, that is tasked with ensuring the Civil Defence Act is implemented. It has the regulatory and compliance assurance function for fire-related hazards, HAZMAT hazards, and other specific public safety hazards that require pre-emergency evacuation plans for buildings, companies, industrial plants, and other critical infrastructure. Public Authority for Civil Defence does that apart from the NCEM and as an integral part of its mandate.

8.7 Network Analysis

To comprehend how inter-organisational coordination cooperates during the response phase and risk reduction phase, the 48 interviewees were asked to identify organisations/sectors they considered most influential in the response phase and in the risk reduction phase. Based on the answers gathered, a network matrix was developed as the basis for this network analysis.

The response network and risk reduction network are further explained in graphic form in Fig 28 to demonstrate how they function. While Table 21 displays a comparison between the two networks.

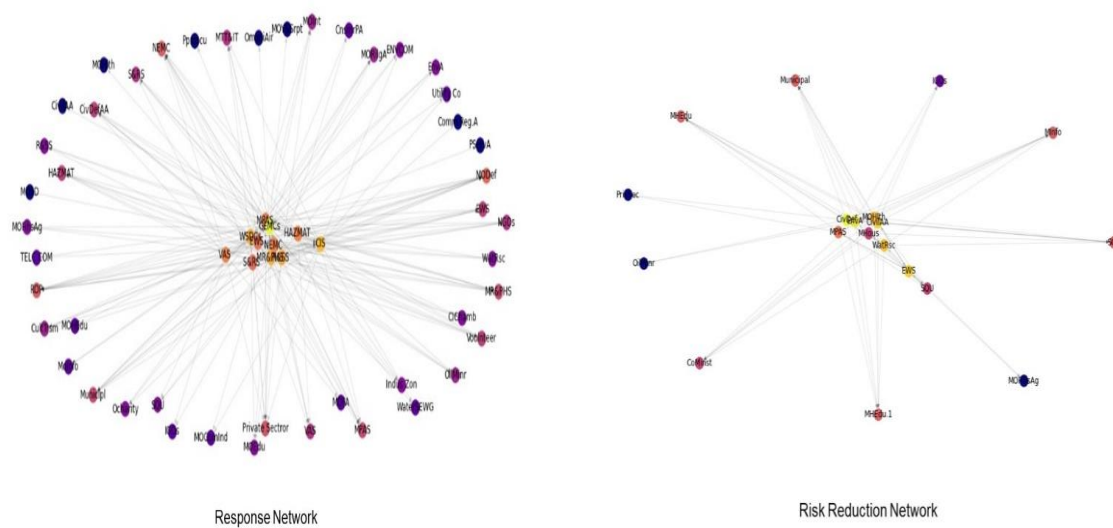


Figure 28: Response Network and Risk Reduction Network (Bastian et al. 2009)

Table 21: Comparison between Response Network and Risk Reduction Network (Author 2022)

	Response Network	Risk Reduction Network
Total Degree Centrality	GEMCs, CIS, MR&PHS, WSDCs, R&SS	CivDef, EnvA, EWS, CivilAA, WatRsc
Density	The density of this network is 0.06 showing sparse connectedness.	The density of this network is 0.187 showing sparse connectedness.
Centralization	The overall degree of centralization is 12%. indicate that a large number of organisations were not in communication with other organisations.	The overall degree of centralization is 15.4%. indicate that a large number of organisations were not in communication with other organisations. The Civil Defence node has a bigger size compared
Degree of connectedness	0.226. (A connectedness score of 1 suggests that all actors are reachable to each other and a	0.71 (A connectedness score of 1 suggests that all actors are reachable to each other and a deviation from 1

	deviation from 1 indicates the fragmentation of the network)	indicates the fragmentation of the network)
--	--	---

The density of the response network is 0.06, and the density of the Risk Reduction network is 0.187, which means that the edges in the RR network are slightly denser than the Response network. The two graphs show differences in visualisations for both networks. The response network database is more centralized than the decentralized visuals in the risk reduction network. However, many nodes in the risk reduction network have a high degree of centrality. Besides, there is a centralised node for organisations' decision-making to control the process from one central place.

The dominant actors in the response network are Governorates Emergency Management Committees (GEMCs), the Critical Infrastructure Sector (CIS), the medical Response and Public Health Sector (MR&PH), Wilayat Development Committees (WSDCs), and the Relief and Shelter Sector (R&SS). However, in the risk reduction network, the most influential actors (Public Authority for Civil Defence (CivDef), Public Authority for Environment (EnvA), Early Warning Sector (EWS), Authority for Civil Aviation (CivilAA), and Department of Water Resources (WatRsc). Figures 28 above visually prove the significant change in nodes and ties, demonstrating a radical difference between the Risk Reduction and Response networks. Specifically, the Risk Reduction network nodes are way less than the Response network and more clustered and connected. In this respect, the RR network is set apart from the Response network.

According to the Risk Reduction network, the Public Authority for Civil Defence (CivDef), Public Authority for Environment (EnvA), Early Warning Sector (EWS), Authority for Civil Aviation (CivilAA), and Department of Water Resources (WatRsc) are the most important actors in the network. At the same time, Governorates Emergency Management Committees (GEMCs), Critical Infrastructure Sector (CIS), (Medical Response and Public Health Sector (MR&PH), Wilayat Development Committees (WSDCs), and Relief & Shelter Sector (R&SS) are more central in the Response network. The difference is reflected in the individuation of brokers in both networks. In the response network, Governorates Emergency Management Committees (GEMCs) are apparently the most important node concerning keeping the network connected, while the Public Authority for Civil Defence (CivDef), Public Authority for Environment (EnvA), Early Warning Sector (EWS), Authority for Civil Aviation (CivilAA),

and Department of Water Resources (WatRsc) emerge in the Risk Reduction network. Subsequently, many nodes have a high degree in the Risk Reduction network. However, there is no specific influential node available in this network to control the activities of all the organisations. Creating information flow and spread are essential in the network. Therefore, it is necessary to create a network of the organisation to act as a centralised network, like a formal emergency management system.

8.8 Conclusion on the Response Vs Risk Reduction Networks

This section gives an overview of findings from Response versus Risk Reduction approaches in Oman disaster management. A comparison of the two networks is summarised, as well as identifying some challenges that may require sustained attention by the Government of Oman and other stakeholders. The similarities and differences identified can be classified as organisational, maturity, and effectiveness.

Organisational Performance: There were strong similarities identified in terms of strategic objectives, organisational structure, strategic framework, and policies and plans. It is expected since the ODMS started in 1988 as an entire response organisation, later named as the National Committee for Emergency Management. However, document analysis shows that until 2007, after the Government of Oman adopted the Cyclone Guano Report, it led to the emergence of ODMS as a modern cluster-based disaster management system. Hence, the strategic objectives in response and RR show complementarity in achieving the goal of national resilience to disaster. Indeed, the policies and legal instruments developed are applicable in both phases. In addition, the organisational structure used in both phases is unified, multi-level, and function-based. However, the main difference is that not all sectors participate actively in response and not all are directly involved in risk reduction. Besides, there are differences in the procedure for implementing Response operations and risk reduction projects.

This study also identified differences in the roles and responsibilities and the type of mechanisms for achieving objectives. There is a further key difference on the issue of accountability. Organisations engaged in designing and implementing RR projects sometimes act independently or multilaterally. They do not have to go through the established hierarchy like the process in all Response activities, which raised some concerns from top managers in the ODMS. On the other hand, Communication and coordination are other two critical functions with similar organisational structures in response and RR. However, it is clear that

intersectoral coordination is much more effective in the response phase than it is during the risk reduction phase.

Maturity: The description of a disaster makes it unpredictable, particularly in terms of timing and impact. Whether natural or human-made disasters, their impacts on communities may be catastrophic and can affect social, economic, and civil infrastructure. The effects can also devastate the environment. Maturity is about readiness to respond effectively to disasters. The lessons learnt in the wake of the destructions and loss of lives attributed to the 2007 and 2010 cyclones that hit Oman give credence to the signing of the Hyogo Framework for Action and the Sendai Framework for DRR by the Government of Oman. The findings in this study show that the Government of Oman is committed to the two protocols and takes charge of disaster management in the Response and RR phases. More findings indicate that the government accepts primary responsibility for achieving RR and community resilience. It developed and introduced a considerable number of measures to promote and facilitate strong participation and strengthened collaborative ties among public organisations, the private sector, civil society, and international humanitarian organisations in the three levels of disaster management and the two phases of disaster, response, and RR.

Achieving resilience in ODMS can be described as the end product of complex interactions and disaster management processes. It requires identifying the best way to approach improved performance in the ODMS. However, improved performance depends not only on understanding and explaining national and community vulnerabilities but also on the ability of managers in the disaster management system to develop strategic objectives and implement effective measures to achieve objectives. The similarities and differences in strategic objectives and the strategic framework identified above will help identify gaps in synergy in the overall disaster management system.

This study has shown that national policy and legal frameworks exist for response and RR activities. However, there is a difference in achieving the objectives in Response and RR. The Response's objective is achieved through a centralised system of responsibilities. In contrast, RR has a decentralised approach to responsibilities and capacities, although RR's policy and planning tools and that of Response in Oman are interconnected. It was further observed that even though there is a difference in approaches, there are some common challenges faced in implementing RR and response policies and action plans. The first challenge is the capacity of local communities to implement RR and Response measures using Wilayat-level mechanisms.

Interviewees revealed that the capacity at the Wilayat level is weak, and only a few WSDCs are currently operational. Secondly, although RR and response are government priorities, there are competing needs that divert attention and resources. Consequently, the interviewees believe there is often insufficient earmarking of financial resources to implement plans and activities in both RR and response (especially RR).

Effectiveness: However, the features of each sector and contributing agency vary in terms of roles and responsibilities. There are established systems at the National and Governorate levels that facilitate command and control of incidents, logistics, and inter-agency coordination and communication. The effectiveness of these is dependent on the clarity of roles and responsibilities. The roles and responsibilities are evident in the NEMP, GEMP, Sector plans, Main Agency plans, and SOPs. However, although there were similarities in the effectiveness of inter-agency structures and communications protocols, a noticeable difference appeared in the procedure for sharing assets in response and RR. In addition, interviews show that the NCEM has been more effective as a response organisation than an RR coordination organisation. The research also identified effective field leadership in response-oriented organisations but relatively weaker leadership in the RR system.

Findings in this research indicate differences and challenges in coordination and information-sharing. The challenges in information-sharing appear at the individual, agency, and community levels. These challenges need to be addressed more pragmatically since communication is essential to effective coordination in both phases. Effectiveness in coordination in response in Oman was identified as resting primarily on the interpersonal skills of the coordinators. In contrast, RR coordinators rely more on their technical skills. Below in Table 22 is a summary of the similarities and dissimilarities of DRR and R &R in Oman.

Table 22: Comparison of RR and Response in Oman (Author 2022)

Issue	RR	Response
General Structure and Organising Principles	The existence of structures is identified in the NEMP and the CD Law. The two specific sectors are created for DRR, and EWS is tasked with risk reduction coordination. MPAS is tasked with long-term risk education/awareness program coordination. However, neither are active in carrying out their risk reduction duties.	The existence of structures is apparent in the NEMP and the CD Law. It is well practised.

Command & Control	Overall, NCEM is the leading organisation in charge of developing policies and coordinating disaster risk management, including risk reduction efforts/measures. However, NCEM does not practice its risk reduction role. Risk reduction is left to each concerned ministry to do what is within its speciality area. Risk reduction requires coordination alignment, and integration of risk reduction policies and projects.	Command and control are well-defined and practised at the three levels of response. There is a well-established incident command system with an organised response structure defining, roles and responsibilities, authority granted, planning process, resources sharing, and more.
Coordination	The NEMP specifies that NCEM, through its EWS, should carry out risk reduction coordination. Therefore, the risk reduction sector is represented in all the ministries with risk reduction roles. However, EWS is inactive in tasks related to risk reduction. Neither the EWS nor the executive office of the NCEM (who should follow and keep track of the performance of all sectors, including the EWS), are putting efforts into fulfilling risk reduction phase tasks. Thus, the risk reduction sectoral approach is not as successful as in the case of response.	There is a well-coordinated response system at the national and governorate levels. However, the system at the local (Wilayat) level is not yet fully implemented. In addition, only one sector operates at the Wilayats level (R&S through WDSC). Therefore, a sectoral approach with a national coordinator and governorate coordinate proves effective disaster response.
Communications and public information	Risk communication is still done in the pre-2010 format; each concerned ministry coordinates with the education system and media organisations in developing risk awareness and educational programs and activities that fall within its specialisation. MPAS is inactive in coordinating and directing long-term awareness programs concerning risk reduction. Besides, MPAS and EWS coordinate with each other in risk reduction-related awareness programs.	MPAS does an excellent job of coordinating public information campaigns during emergencies. Its JMC is activated during emergencies and fully operational in the response phase.
Resources Sharing/ Financing	Risk reduction funding is provided by the central government/cabinet office, and is included in the annual budgets for each ministry after approval from the SCP as part of the national development plan. There are times when HM the Sultan would order certain risk reduction projects in response to significant incidents/disasters that happen domestically or internationally.	Response resources are provided by public organisations, NGOs, and private organisations. The government reimburses or compensates contractors in the private sector for works done during response. There is also a budget allocated for disaster response used during the response to emergencies. Critical response assets (planes, vessels, etc) are acquired as part of each organisation's annual budget plans. NCEM makes sure that such resources are available and coordinates the gathering of resources.

Finally, Table 22 above shows that the issue of achieving vertical and horizontal integration through coordination is still a significant hurdle for coordinators to overcome in light of the differences in RR and response coordination. In particular, the study shows that RR in Oman is still practised the old way, with each agency working independently. However, RR principles and defined roles and responsibilities in the NEMP are not implemented in the risk reduction phase, in contrast to the response phase. This finding is also observed at the National, Governorate, or Wilayat levels. Implementation of RR is therefore an issue that must be reviewed in the Oman Emergency Management System.

8.9 Conclusion on the Discussion of Findings and Results

The literature review in this study provided valuable insights into how to conduct a study that investigates the form, nature, and effectiveness of sector-based disaster management. Social Network theory provided the foundation for developing this study's conceptual and theoretical framework.

Lessons learned from SNT were useful in this research study. It provided insight into the importance of adopting a holistic approach to assessing and enhancing inter-organisational/intersectoral disaster management systems. At the same time, it provides the foundation for a new approach to Disaster Risk Reduction (DRR) in Oman. SNT Theory also provided a better understanding of the interactions and reactions among the diverse components of the system. It helped evaluate the coordination system in place as well as identify the presence or absence of relevant factors to determine the conditions for effective disaster management systems.

The Social Network Theory is the conceptual foundation applied to analyse, to understand the interactions in a complex system such as the Oman multi-organisational DMS. Thus, SNT provided a framework to assess the effectiveness of the various network theories in inter-sectoral coordination like the Oman Emergency Management System, and on its part, also developed the method that was used to map and analyse the disaster management system network. Lessons learned from the Social Network Theory also included the importance of organising and empowering the WSDCs to facilitate the smooth running of response networks. The Social Network Theory also provided valuable insights into sharing responsibilities and resources across the Oman disaster networks. The theory was also critical in understanding the enhancement of inter-agency interactions.

SNT Theory also provided support in understanding how to identify what coordination mechanisms are needed in disaster response and disaster risk reduction in the Oman DMS. Lessons learnt from the theory included how regulation, leadership, standardisation, planning, mutual adjustments, and direction can enhance inter-sectoral coordination both in RR and response.

Moreover, findings in this study indicate that Oman has chosen an ‘all hazards and all stakeholders’ approach in the post-2010 NDMS. Oman's approach to hazards aligns closely with the UNDRR comprehensive disaster management approach. In this new approach, Oman views disaster management as a complex activity that requires a holistic approach to managing complex interactions and relationships within the system.

Accordingly, Oman developed an NEMP that was revised and endorsed in the Inspector General of Police and Customs Decision 28 of 2018. The revised plan maintains NCEM as the lead organisation operating through the National Emergency Management Centre (NEMC). The leadership style is a command-and-control system with the Inspector-General of Police and Customs as Chairman and the Deputy Inspector General of Police and Customs as the head of the NEMC, with each sector, represented in the NEMC. Although there is a vertical command and control structure in place, the general finding in this study regarding leadership style is that there is a substantial degree of decentralisation. Nonetheless, all indications are that gaps still need to be addressed in the structure and operations within NDMS. One such gap identified in the structure is that GEMCs do not have standard operating systems, resulting in disparities in the implementation of NEMPs across GEMCs.

The study findings also indicate wide variations in the implementation of the national plan by sectors and lead agencies. Hence, the DMS across sectors needs to be standardized. Besides, the system has not yet been formulated at the Wilayat level of the sectors. Communication interoperability is another key challenge that needs to be addressed. Currently, each sector depends on commercial telecommunication companies for communication with other sectors. However, communication is a problem, there appears to be a well-established network of organisations across sectors with the interdependencies of each actor well recognized.

This study sought to explain one salient issue relating to how inter-sectoral coordination operates in the post-2010 Omani DMS and how effective it is. The literature review for this study identified common understanding as a vital prerequisite in the integrating conditions for inter-sectoral coordination (Okhuysen and Bechky 2009). According to Okhuysen and Bechky

(2009), a common understanding can be developed through formal and planned, or informal mechanisms. The general findings presented in this section indicate that NCEM needs to develop more effective formal and informal mechanisms for coordination, particularly for risk reduction issues. For instance, the Early Warning Sector developed the first Country Risk Register in 2010. Although, a permanent Risk Analysis and Horizon Scanning Working Group is in place; the register has never been revised or updated. In addition, the general view of participants in this study is that NCEM has placed more emphasis on preparedness and response and that the performance of NCEM in RR has not been encouraging enough. Therefore, there is a need for NCEM to broaden its scope to function more effectively on RR.

Chapter 9 General Conclusion

The purpose of this research is to examine the form, nature, and effectiveness of the post-2010 Omani disaster management system. This research is based on the assumption that there is a lack of empirical understanding of the effective structure of multi-organisational emergency management networks. Moreover, there are limited research studies comparing and assessing the changes in emergency network structures in the various phases of emergency management (Kapucu and Hu 2020). The research pertaining to the effectiveness of disaster networks mostly concentrates on factors shaping the structure of response networks (Jones 2016).

The study builds on and contributes to the literature on networks and governance in examining intergovernmental and inter-organisational relations in Oman's emergency management systems.

This thesis used Social Network Analysis (SNA) and qualitative research methods to investigate how inter-sectoral coordination operates, identify all the relevant Oman DMS components, develop a framework for assessing the Oman DMS, and how effective it is in the post-2010 Omani disaster management system.

This chapter provides a general summary of the thesis. It starts with a review of the research objectives and then summarizes the main findings of the study. It highlights the theoretical, practical, and methodological contributions of the study. Finally, it discusses the study's limitations and explores the opportunities for further research.

9.1 Review of Research Objectives

9.1.1 Objective One

To explore the possibilities of establishing an effective, inter-sectoral co-ordination framework as an approach to disaster risk reduction and response in a disaster management system.

Towards achieving this objective, it was important to critically review the complexity of disaster and its models like complex adaptive systems to establish the connection and contrast between existing theories relating to inter-organisational network structure. However, there remains a need to understand how complex networks function. At the same time, it explains how to measure the intensity of the linkages between the various components. According to

Abbasi et al. (2015), the management of complex adaptive systems must understand the practicalities of coordination, ranging from micro to macro scales. It can be achieved by investigating the visualisation, centrality, degree of distribution, and other existing factors.

This led to exploring the meaning and understanding of Social Network Theory, the main theoretical background of this thesis, and its effectiveness in disaster management in a complex environment. Social network theory provides a framework for developing methods that can be used to map and analyse the disaster management system network by focusing on understanding the behaviour of people and groups as they form bonds with each other.

Thus, the conceptual framework of this research study is developed around a Social Network approach to examine the efficiency and effectiveness of existing complex inter-sectoral coordination and coordination mechanisms within each cluster and among all clusters in the Omani disaster risk reduction and response system. It is used to evaluate differences between disaster response and risk reduction in Oman as well as make suggestions and examine structures, policies, and actions in the NDMS using three lenses: network governance, network characteristics, and network coordination functions. These dimensions provide a comprehensive approach that can be used to explain why inter-sectoral coordination is necessary, how it should be conducted, who is to be studied, and what coordination mechanisms are required. Integrating the three inter-sectoral dimensions into a practical holistic framework assumes a model that considers the Omani National Disaster Management System (NDMS) as a complex adaptive system, although feasible using the insights obtained from the Social Network Theory.

Network governance provides the framework for understanding the ‘what’ in this research by explaining the tenets of network governance i.e., legitimacy, accountability, and leadership in the Oman situation. Furthermore, it will identify collaborative structure and systems in inter-organisational disaster response and risk reduction networks used in the Oman DMS in governance structure, policies, collaborative leadership practices, mutual adjustments, and direction. The study will identify what further steps agents in Oman need to take to enhance collaborative governance in RR and response networks.

The second dimension of this conceptual framework is to guide disaster management and clarify network characteristics. This dimension uses Social Network Analysis (SNA) to identify who the agents are and, when, and where they need to link and change their behaviour to enhance DMS in Oman. An additional aim is to understand the social bonds that emerge in

disaster situations in Oman and to identify who the actors are in each action. Thus, the overarching aim is to investigate the level of visualisation, centrality, and distribution in the system.

The third dimension of this conceptual framework is Network collaborative functions. Network collaborative functions will provide the foundation for identifying the coordination mechanisms available in the Omani disaster response and disaster risk reduction systems. Therefore, the objective is to identify the coordination mechanisms in disaster response and disaster risk reduction that are used in the Oman DMS regarding regulation, standardisation, planning, capacity building, and information management. Besides, the dimension underlines the considerable benefits of coordination functions in the disaster management systems in Oman to reorganise disaster management nodes and centres. This includes coordinating the resources systems required for effective response and risk reduction at various levels of the disaster management system. Consequently, it will be helpful in the formulation of proposals for methods to make the disaster system more efficient and effective.

The conceptual framework of this research has proven to be substantially valuable and provided insights into the analysis of the documents and conducted interviews as a result of the Social Network Theory adopted. The key elements in SNT were effectively used to respond to the research objectives outlined in this research, as well as the research questions listed in the study on disaster risk reduction and response in Oman. Thus, the three lens dimensions, namely network governance, network characteristics, and network collaborative functions are the main attributes of Network Theory that were utilized in this research to explain Oman's disaster management system. The Social Network Theory's three-lens dimension diagram inherent in the conceptual framework helps understand social networks from three different perspectives by providing a comprehensive and multi-dimensional approach to studying ODMS. At the same time, allowing the researcher to gain insights into the interactions and dynamics at various levels of analysis, from individual actors to the overall network structure and its societal implications.

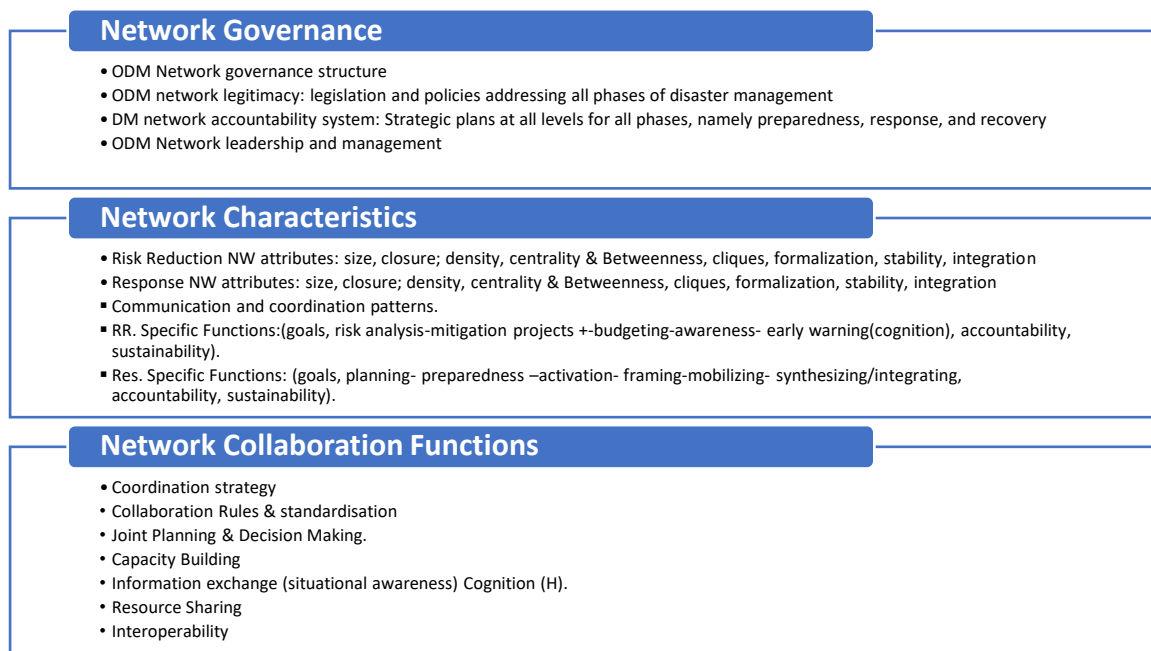


Figure 29: Three-Dimension Conceptual Framework Used to Assess the Effectiveness of Intersectoral Coordination in Oman Post 2010 Disaster Management Systems (author 2022)

9.1.2 Objective Two

To examine the reliability and effectiveness of existing complex inter-sectoral coordination and coordination mechanisms within each cluster and among all clusters recognised in the post-2010 Omani disaster risk reduction system.

This research aimed to provide a comprehensive understanding of inter-organisational coordination within Oman's emergency management networks, focusing on two critical phases: the risk reduction network and the response network. To achieve this objective, the conceptual framework developed in this research was employed to explore the intricate dynamics of these networks. The dimension of network governance has allowed the researcher to delve into the structural and institutional aspects of these networks. The research has uncovered aspects related to legitimacy, accountability, the roles of leadership, the decision-making process, and power distribution in shaping a network's effectiveness. This dimension emphasized the importance of governance structure to facilitate coordination.

The dimension of network collaboration functions has examined the functional aspects of collaboration and coordination within these networks. It has enabled the researcher to dissect

the various collaborative functions, such as information sharing, resource allocation, capacity building, and joint planning. Research findings highlight the significance of fostering a collaborative culture and establishing mechanisms to facilitate these functions.

The dimension of network characteristics grounded in social network analysis provided insights into network attributes. Through the assessment of connectivity, centrality, and other network metrics, the research has identified structural characteristics and key actors and organisations that play crucial roles in the coordination process which helps in evaluating the existing mechanisms and identifying areas that need improvement. These attributes have been pivotal in understanding the network's underlying architecture.

The framework provided an explanation for the second research objective by pointing out the existence of inter-sectoral coordination mechanisms, as well as the ineffectiveness in most of the sectors, including the inability of the Oman DM system to achieve its potential.

This study identified flaws and gaps in the post-2010 Omani disaster management system (ODMS) by using a multi-attribute conceptual framework to ascertain the flow of information, resources, and decision-making processes between sectors, which are essential for effective coordination, and to identify approaches and practices for improving coordination and collaboration among different sectors in the Omani disaster management system.

Main Findings

Using the three main dimension framework provided an analytical tool throughout this research in analysing the relationships and interactions between different actors and sectors, and examining inter-sectoral coordination in disaster risk reduction and response networks in Oman. The research has revealed that the nature of inter-organisational coordination differs significantly between the risk reduction and response phases. Risk reduction demands long-term planning and resource allocation, while the response phase necessitates rapid and adaptive coordination. Tailoring strategies to the specific demands of each phase is crucial for effective emergency management.

Findings discussed in Chapters 5, 6, 7, and 8 show the practical use of SNT in assessing intersectoral coordination in disaster management networks in Oman. Strengths and weaknesses of the response network and risk reduction network were evaluated focusing on all sectors connected to the Omani DMS.

Findings from both document analysis and interviews prove that Oman has a standard emergency management system/structure. However, it aims at minimizing risks and reducing their effects through multiple practices that fall under the various phases of disaster management, such as mitigation, preparedness, response, and recovery. In practice, such a structure/system focuses more on a response (a response-oriented structure), overlooking the risk reduction aspects of disaster management. Research findings indicate that the Omani National Committee for Emergency Management (NCEM) places minimal emphasis on risk reduction and almost exclusively concentrates on disaster response. It is clear from the findings that Oman lacked a solid institutional structure concerning risk reduction, unlike the response system, which is the government's focus.

Network Governance: The Emergency Response Network Governance Assessment revealed the Emergency Response Network is characterized by strong government support, high public acceptance and legitimacy, robust accountability mechanisms, and strong leadership characteristics. Furthermore, this well-structured emergency network included roles, responsibilities and accountabilities clearly set forth - creating the conditions necessary for an efficient disaster response strategy.

However, the Risk Reduction Network appears fragmented and disorganised in terms of governance and operational mechanisms; its legitimacy remains questionable as NCEM's roles aren't widely appreciated in risk reduction strategies; lacks an organised approach for risk mitigation; implementation issues with roles/responsibilities not clear or properly executed as specified; leadership/coordination gaps present themselves significantly making for the less mature and effective network than its ERN counterpart.

The empirical investigation carried out in this thesis reveals that most interviewees agreed with using an effective risk reduction strategy in the post-2010 ODMS to serve as a map for implementing the Oman National Disaster Management Plan. Conversely, the findings from interviews with stakeholders in DMS show that the effectiveness of inter-sectoral coordination in the risk reduction phase depends on the strict implementation of the NEMP guidelines, a solid accountability system, and an effective network leadership structure.

Network Structure: Additionally, the disaster management framework constructed in the National Emergency Management Plan (NEMP) on risk reduction differs from how it is implemented. Nevertheless, the findings demonstrated that each ministry has assumed and is

carrying out the obligation of risk reduction as part of the extension of its responsibilities. Visual representations of the risk reduction network and the response network using social network analysis tools prove the significant change in the number and members, demonstrating a radical difference between the risk reduction network and the response network. The research highlights the fundamental distinctions between Oman's networks for risk mitigation and emergency response. In particular, the Risk Reduction network nodes are way fewer than in the response network. It shows another relevant difference concerning centrality scores. For example, in response networks, the Governorate EM Committees (GEMCs) and National EM Centre (NEMC) appear to be the most central according to most criteria. According to the risk reduction network, other organisations like the Civil Defence Authority (CivDef), Civil Aviation Authority (CivilAA), and Department of Water Resources (WatRsc) are the most important in various attributes. The difference is reflected in the individuation of brokers in both networks. In the Response network, GEMCs are the most important node in keeping the network connected, while the Civil Aviation Authority (CivilAA), Department of Water Resources (WatRsc), Ministry of Health (MOHlth), and the Environment Authority (EnvA) emerge in the risk reduction network. However, many nodes have a high degree of centralities in the risk reduction network, meaning the lack of a central coordinator or leader organisation. As a result, neither the NEMC nor another specific influential organisation is available in this network to control and coordinate its activities.

Therefore, this research recommends a reevaluation of risk reduction networks' structures by adding elements of centralization that enhance the reach and flow of information within them. Doing this could improve efficiency as well as clarity during decision-making and coordination processes.

Network Coordination: Further findings show that, in contrast to response, the operationalization of risk reduction is inadequate, lacking proper coordination and a clear purpose. This thesis argues the effectiveness of inter-sectoral coordination in the disaster management cycle, which is one of the objectives of this study. Thus, chapters 6 and 7 of this thesis further stress that while Oman's response network has an effective coordination system, its reduction network has some serious weaknesses in coordination functions (i.e., information sharing, resource sharing, decision-making, and task integration). Assessment of collaborative functions has demonstrated that the Emergency Response Network displays a more structured and cohesive approach to coordination, with clear guidelines, information-sharing protocols,

and a unified approach to emergency response. Furthermore, the network benefits from strong leadership, standardised procedures, and a culture of collaboration.

Risk reduction shows greater fragmentation and lack of central leadership than its counterpart, suggesting there's room for improved integration of planning, joint actions, and unified strategy implementation to create more integrated approaches towards risk reduction.

All interviewees agreed that an emergency management system requires an effective framework to coordinate the process. Therefore, the inter-sectoral concept can help achieve and coordinate long-term planning of all sectors and specialists from different fields involved in the risk reduction phase. However, most quoted interviewees argued that the practical application of the inter-sectoral coordination mechanism in Omani DMS depends on the availability of sufficient resources to implement the plans successfully. They further stressed that the shortage of resources could hinder the execution process and cause a breakdown in the chain coordination inherent in the social network scheme (see Chapter 7, section 4.3).

In this regard, the findings from the theoretical analysis and data from the interviews prove the efficiency of social network theory in assessing and enhancing complex disaster management systems. This demonstrates the operationalisation of the framework in analysing disaster management systems, such as the case in Oman in terms of strategies, measures, and processes in place for various phases of disasters (i.e., response and disaster risk reduction phases).

Appendix (1) provides a summary of findings based on the conceptual framework used in this research.

9.1.3 Objective Three

To provide recommendations for inclusion in strategic and operational guidelines for both formal and informal inter-sectoral coordination in a reformed post-2010 Omani disaster management system, as informed by theoretical and empirical findings.

The research was able to contribute to the enhancement of the post-2010 Omani disaster management system as an answer to the research questions by providing an explanation of the current network identifying its shortcomings and proposing change and modification to enhance its effectiveness between sectors and facilitate seamless communication and cooperation during disaster response and risk reduction efforts.

Subsequently, the conceptual framework provided by SNT contributed to the development of recommendations for enhancing inter-sectoral coordination functions in disaster management systems based on an understanding of the network structure and dynamics.

This research identified the strengths and weaknesses of the ODMS, as well as similarities and dissimilarities between the various phases in the DRM. This section provides some recommendations that the thesis informs and could be helpful to improve ODMS in Oman.

First, SNT can be used to locate and map the important parties participating in emergency management, including governmental and non-governmental organisations, and other interested parties. This will enable policymakers and practitioners involved in ODMS to simplify and spell out each sector's job description and responsibility in Disaster Management. It would enable stakeholders and the public to know the duties of each sector to avoid confusion, for easy identification, to prevent duplication of tasks, and to check the concentration of tasks on one sector, thereby making some sectors redundant. In addition, it would help differentiate between the sectors involved in the response and recovery phases.

Second, policymakers and practitioners in ODMS should reevaluate and realign the focus of NCEM to ensure it actively contributes to disaster risk reduction. This task seeks to ensure effective implementation and coordination of risk reduction structures and objectives outlined in the National Emergency Management Plan (NEMP), through appropriate mechanisms established for the National Emergency Management Committee (NEMC), especially with regard to various ministries implementing risk mitigating measures; thereby fostering collaboration and coherence of risk reduction efforts. Another option is for Omani policymakers to create a central organisation under either NEMC or an independent Network Administrative Organisation (NAO) to govern the risk reduction network mandated with developing a comprehensive risk reduction strategy. The key role of such an organisation should be to coordinate, assess, and track the implementation of risk reduction measures across different ministries and agencies, ensuring a unified and strategic approach.

Third, policymakers and practitioners in ODMS should work toward strengthening the risk reduction governance structure. This includes establishing a detailed governance structure. The governance structure should be able to assign clear roles/responsibilities, manage expectations for member organisations, and ensure its accountability to a higher authority. In addition, the structure will need to develop and implement an effective performance assessment system to streamline decision making processes and reduce ambiguity in the risk reduction phase.

Fourth, policymakers and practitioners in ODMS should work toward promoting a collaborative culture in the risk reduction phase. The NCEM should foster a culture of collaboration by promoting trust, communications, and information sharing among risk-reduction network members. Attaining this goal could involve establishing regular meetings, creating information-sharing platforms, initiating collaborative projects, encouraging joint planning and resource sharing, and setting common goals and objectives to enhance a network's ability to address shared risks more efficiently. Establishing formal agreements or mutual aid pacts between response organisations could significantly enhance ODMS' intersectoral coordination and facilitate more efficient and coordinated responses to emergency events. Similarly, there is a need to provide appropriate resources and capacity-building programs for disaster risk reduction. This includes training and equipping personnel with the skills required to develop and implement risk reduction policies and measures.

Furthermore, interagency coordination during risk reduction could be improved through the implementation of standard operating protocols for various risk reduction activities.

Fifth, policymakers and practitioners in ODMS should monitor emergency management network attributes through network analysis to detect structural weaknesses and opportunities for improvement. For example, as revealed in the findings of this research, there is a need to develop and implement a comprehensive emergency management structure at the local (Wilayat) level with an effective intersectoral emergency response network. This will ensure that each Wilayat has a formulated emergency response plan and coordination mechanisms. Using SNA, NCEM can identify and engage key organisations with high centrality to act as bridges or facilitators in local response networks.

Sixth, the Omani Disaster Management System should develop resilience through network structure to disrupt redundant connections, while building alternative communication pathways to ensure that the network can withstand failures or breakdowns in communication during emergencies. This could include providing response networks with state-of-the-art telecommunication systems, which might range from IT information-sharing systems and backup communication systems to improving interoperability by developing dedicated communications systems for response organisations. This could have the beneficial outcome of ensuring reliable communication channels during emergencies which can significantly enhance communication and coordination during emergencies.

Seventh, emergency management plans need effective coordination to enable them to play an essential role in assisting communities prone to natural disasters in adapting to the adverse effects of climate change. For the EM Sectors to materialise and be proactive, the emergency management system needs more sophisticated coordination units that can replace the present part-time coordinators with committed professionals and sufficient resources. This enhanced capacity could drive forward increases in intersectoral collaboration within the system.

Eighth, an innovative ODMS strategy should be implemented to urgently incorporate the private sector to play a functioning role in the emergency management system. This would increase the private sector's effectiveness in various emergency scenarios and make necessary adjustments to improve its performance. As a result of its active role in disaster management, it complements the government's efforts. It would enable professionals and independent civil groups to offer novel suggestions for enhancing Oman's emergency response system. Additionally, it would lessen OMES' excessive reliance on the government for resources while lowering the danger to investments posed by disasters that occur frequently and sustaining progress on both an economic and human life scale.

Lastly, Oman should have a standard template to assess its response and risk reduction networks as illustrated in the SNT conceptual framework diagram in Figure 2. Even though the nature of disasters may differ across regions in Oman, the impacts are similar. Therefore, Oman DMS should develop a futuristic plan based on effective network theory like SNT to tackle the emerging challenge of climate change, which is now a prevalent threat to its environment. In addition, Oman's conceptual framework for future disaster management should follow the international practice recognized by the UNISDR to ensure effective coordination and provide a durable solution for its emergency management system.

Implementation of these recommendations could result in a more cohesive, centralized, and effective disaster management system in Oman by better coordinating and aligning efforts across ministries and agencies.

9.2 Limitations

There are a few limitations with respect to this research. One of them is that there is no literature specifically on using social network analysis to assess interorganisational emergency management networks in Oman. Secondly, data collection can be challenging as it relies on organisations willingly sharing information, which might not always be the case due to

concerns about confidentiality. Additionally, the quality of the data collected can vary, affecting the accuracy of network representations. Thirdly, the static nature of many social network analysis methods might not capture the dynamic nature of these emergency management networks where relationships and information flow can change rapidly. Furthermore, social network analysis may struggle to account for informal or implicit connections that are crucial in real-world coordination efforts. Lastly, interpreting the results can be complex, as network metrics alone may not provide a complete understanding of the nuanced social dynamics and contextual influence factor. This is one important reason why the researcher has developed the three-dimensional conceptual framework to assess intersectoral coordination in Omani DMS.

9.3 Contributions

This research contributes significantly to the understanding of disaster risk reduction and response in Oman and the region. By applying these methodologies to a context like Oman, which is vulnerable to various natural and man-made disasters, this research sheds light on the intricacies of coordination and collaboration among organisations involved in risk reduction and response efforts. This research can help policymakers and practitioners in Oman and beyond to enhance the effectiveness of their disaster management strategies, ultimately improving resilience and reducing the impact of emergencies. Moreover, this research adds valuable insights to the broader field of social network analysis by showcasing its applicability in diverse cultural and geographic settings, thereby expanding the knowledge base for more effective disaster response worldwide.

This thesis's value to existing knowledge is part of the point established in this conclusion. This section shows the contributions of the conceptual framework to already known knowledge as outlined in this thesis in terms of new information derived from the theoretical discourse and findings, which were fundamentally argued. It is further established in this thesis that the intersectoral coordination inherent in social network theory is a practical conceptual framework that can be applied in a complex emergency system, as exemplified in the post-2010 Omani disaster management system.

Therefore, it is imperative to repeat this thesis's contributions to knowledge. First, this thesis argued that one of the significant contributions that this thesis will make to advance knowledge is to develop an improved concept of inter-sectoral coordination with a specific focus on a case study of Oman. Therefore, the debate concerning how we understand and conceptualize inter-

sectoral coordination remains a key integrative feature across emerging disaster management agendas influencing Oman today. It is noted that discussing emerging knowledge helps to fill the gaps in the field of inter-sectoral coordination. Finally, this study will explain the possibility of establishing a 'complex clustered/inter-sectoral coordination framework' to add to existing information provided by academicians and professionals working on inter-sectoral cooperation/coordination.

Second, the thesis further confirmed that inter-sectoral coordination remained relevant and valuable in complex emergency management systems involving multisector and multidisciplinary institutions that operate in line with global practices (see Chapters 2, 3, and 4.5). Thus, this thesis established that coordination is a critical element of an effective disaster management system, which should not be ignored by inter-organisational agencies involved in emergency management. Thus, for quick response to disaster risk reduction, a central coordination unit is established to connect and manage all sectors associated with the emergency management system for efficiency, reliability, and sustainability to achieve short- and long-term objectives (see Chapter 5, section 3.2).

Third, this thesis re-validates that the study of inter-sectoral coordination as an adequate theoretical framework for improving disaster management in a vulnerable environment signifies its relevance and contribution to existing knowledge.

Lastly, this thesis's contribution to knowledge reaffirms that for an effective emergency management system, a proper conceptual framework should be developed for a lasting solution to disaster management, as shown in this case study of Omani DMS. It is proved in this thesis that such a framework identified key components as reflected in Omani DMS. These essential components: Hazard Assessment Mapping, Vulnerability Assessment, Demographic Distribution, Infrastructure, Lifelines and Critical Facilities, Logistics and Transportation Routes, Human and Material Response Resources, and Communication are included in the composition of the Disaster Management Information System, which provides and serve as information database that allows effective coordination and implementations of policies respond to an emergency (see Figure 12 of Oman conceptual framework in 2022).

This thesis reveals that developing effective DRR plans can play an essential role in supporting communities to adapt to the adverse effects of climate change. Therefore, the Omani government needs to invest in DRR to keep the support rendering vulnerable communities

afloat. However, it is essential to fully understand the dynamics of a disaster before an optimal level of investments can be implemented.

9.4 Future Research Agenda

This research thesis argued that to enhance the pre-2010 events in Oman, a holistic and workable approach is needed to reduce the risk and develop the response capacity through a well-proven conceptual framework. This section reveals that future research is needed to consolidate the existing strategic framework to minimize the effects of hazards through quick response and facilitation of the recovery process in a proactive method without undermining the safety, well-being, and re-habitation of victims into regular activities.

Therefore, while this research has made significant strides, several avenues for future exploration and research remain. The application of social network analysis in analysing the risk reduction and response phases of disaster management presents a rich field for future research. Several avenues for further exploration and development can be identified. For example, academics and practitioners in disaster management can investigate how emergency management networks evolve over time within each phase and across phases. Further research can delve deeper into the patterns of information flow and communication within networks identifying critical nodes and information bottlenecks to enhance the efficiency of risk reduction and response efforts. Moreover, future research can be about comparative studies. This could include conducting cross-case comparisons to identify best practices and common challenges in different disaster contexts. This can help develop adaptable network governance strategies. One significant research area that might enhance intersectoral coordination is utilizing computational models and simulations to test different network configurations and strategies for risk reduction and response. This can provide insights into optimal network structure. Academics and practitioners are required to develop different and more effective analytical frameworks that recognize and attest to the complex nature of disaster management involving multisector and multidisciplinary saddle with multi-tasking responsibilities for coordination in the risk reduction phase (see Chapters 2, 4, and 6). Moreover, interdisciplinary research should be engaged between emergency management practitioners, social scientists, and network analysts to foster innovative approaches in enhancing multi-phase intersectoral coordination. This thesis reiterates that continuous emergency management research would provide stakeholders with new data to improve disaster risk reduction and response management.

In conclusion, it seems clear that the inter-sectoral coordination framework is anchored on the basic concepts of the social network theory. It provides a process to effectively understand the behaviour, communications, and other characteristics of multisector and multidisciplinary related to each other from the micro-level to the macro-level in a complex system (Chapter 2, section 2.1, Lenoir 2018). Thus, social network theory in a broader context is a reliable method and effective during crisis time among inter-sectoral institutions and individuals operating in crisis management based on its proven record in related disaster management studies. It makes it easy to coordinate agencies and institutions from diverse backgrounds to work together on worthwhile projects, especially in a crisis, to improve relationships among individuals and social groups (Butts 2008).

The adoption of a conceptual framework built on social network theory and assessed through the lenses of network governance, network collaboration functions, and network characteristics has yielded valuable insights into inter-organisational coordination within emergency management networks. By addressing the identified challenges and leveraging the strengths of these networks, we can collectively move towards more effective, resilient, and collaborative emergency management systems capable of responding to complex challenges of our time.

References

- Abbasi, A., 2014. Link formation pattern during emergency response network dynamics. *Natural Hazards*, 71 (3), 1957-1969.
- Abbasi, A., Hossain, L. and Wigand, R. T., 2015. *Evolutionary Dynamics of Complex Networks: Theory, Methods and Applications*. Available from: <https://arxiv.org/ftp/arxiv/papers/1503/1503.06652.pdf> [Accessed 25 September 2022]
- Abbasi, A., Sadeghi, N. A., Jalili, M. and Choi, S., 2018. Enhancing response coordination through the assessment of response network structural dynamics. *PLoS ONE*, 13 (2), 1-17.
- Adams, W., 2015. Conducting semi-structured interviews. In: Wholey, J., Hatry, H. and Newcome, K., eds. *Handbook of practical program evaluation*. San Francisco, CA: Jossey-Bass, 492-505.
- Aghajani, H. and Abasgholipour, M., 2014. Empirical study on interorganisational coordination (Evidence case: organisations of job and employment in Iran). *Iranian Journal of Management Studies*, 7 (2), 285-304.
- Agranoff, R. and McGuire, M., 2003. *Collaborative public management: new strategies for local governments*. Washington, D.C: Georgetown University Press.
- Al Saadi, M. K., 2018. *Understanding health emergency management response planning in Oman: perspectives on standardization*. Thesis (PhD). Bournemouth University. Available from: http://eprints.bournemouth.ac.uk/31283/1/al%20saadi%2c%20al%20muatasim%20khalifa%20khamis_m.res._2018.pdf [Accessed 28 May 2020].
- Al-Barwani, A. S., 2016. Omani experience in flash floods, disaster risk reduction and water harvesting. *Proceedings of the second international symposium on flash floods in wadi systems: disaster risk reduction and water harvesting in the Arab region*. Kyoto University 25-27 October 2016. 19-24. Available from: https://repository.kulib.kyoto-u.ac.jp/dspace/bitstream/2433/228082/1/28A-05_19.pdf [Accessed 30th Nov 2020].
- Aldrich, D. P., 2012. *Building resilience: Social capital in post-disaster recovery*. Chicago: University of Chicago Press.
- Al-Maawali, I. H., 2018. *Oman Experience on Telecommunications Emergency Plan*. ACS Publications. Available from: <https://slideplayer.com/slide/14839031/90/images/3/National+Emergency+Management+System+%28NEMS%29.jpg> [Accessed 28 May 2020].

- Al-Manji, S., Lovett, J. and Mitchell, G., 2020. Factors affecting disaster resilience in in Oman: Integrating stakeholder analysis and fuzzy cognitive mapping. *Risks, Hazards and Crisis in Public Policy*, 12 (1), 1-22.
- Al-Shaqsi, S., 2010. Care or cry: three years from cyclone gonu. what have we learnt?. *Oman Medical Journal*, 25 (3), 162–167.
- Al-Shaqsi, S., 2011. *Emergency management in the Arabian peninsula: a case study from the Sultanate of Oman*. Oman: EM Book Comparative Studies Publications.
- Al-Shaqsi, S. Z., 2015. *Emergency Management in the Arabian Peninsula: A Case Study from the Sultanate of Oman*. Oman: The public Authority for Civil Defense and Ambulance. Available from: http://pacdaoman.gov.om/images/pdf/research/Dr_Sultan-Al-shaqsi.pdf [Accessed 28th Sept 2019].
- Amagoh, F., 2008. Perspectives on organisational change: systems and complexity theories. *The Public Sector Innovation Journal*, 13 (3), 1-14.
- Antonacopoulou, E. P. and Méric, J., 2005. From power to knowledge relationships: stakeholder interactions as learning partnerships. In: Bonnafous-Boucher, M. and Pesqueux, Y., eds, *Stakeholders and corporate social responsibility – European perspectives*. London: Palgrave, 125-147.
- Apte, A., Gonçalves, P. and Yoho, K., 2016. Capabilities and competencies in humanitarian operations. *Journal of Humanitarian Logistics and Supply Chain Management*, 6 (2), 240-258.
- Aras, B. and Yorulmazlar, E., 2017. Mideast geopolitics: the struggle for a new order. *Middle East Policy*, 24 (2), 57-69.
- Ashforth, B. and Mael, F., 1989. Social identity theory and the organisation. *Academy of Management Review*, 15 (1), 20–39.
- Axelrod, R. and Cohen, M. D., 1999. *Harnessing complexity: organisational implications of a scientific frontier*. New York: The Free Press.
- Bahadori, M., Khankeh, H. R., Zaboli, R. and Malmir, I., 2015. Coordination in disaster: a narrative review. *International Journal of Medical Reviews*, 2 (2), 273-281.
- Baker, W. E. and Faulkner, R. F., 2002. Interorganisational networks. In: In Baum, J. A. C., ed. *The Blackwell companion to organisations*. Oxford: Blackwell Publishers Ltd, 58-74.
- Ballard, D. I. and Seibold, D. R., 2003. Communicating and organizing in time: A meso-level model of organisational temporality. *Management Communication Quarterly*, 16, 380–415.

- Basak, S., Modanwal, N. and Mazumdar, B. D., 2011. Multi-agent based disaster management system: a review. *International Journal of Computer Science and Technology*, 2 (2), 343-348.
- Bastian, M., Heymann, S. and Jacomy, M., 2009. Gephi: an open source software for exploring and manipulating networks. *Proceedings of the International AAAI Conference on Web and Social Media*, 3 (1), 361-362. Available from: <https://gephi.org/publications/gephi-bastian-feb09.pdf> [Accessed 28th Sept 2020].
- Benjamin, D. J., Choi, J. J. and Strickland, A. J., 2010. Social identity and preferences. *American Economic Review*, 100 (4), 1913–1928.
- Benson, C. and Clay, E. J., 2004. *Understanding the Economic and Financial Impacts of Natural Disasters*. Disaster Risk Management Series paper # 4. Washington DC: World Bank Group. Available from: <http://documents.worldbank.org/curated/en/146811468757215744/Understanding-the-economic-and-financial-impacts-of-natural-disasters> [Accessed 28th Sept 2020].
- Berchtold, C., Vollmer, M. and Sendrowski, P., 2020. Barriers and facilitators in interorganisational disaster response: identifying examples across Europe. *International Journal of Disaster Risk Science*, 11, 46–58.
- Bergstrom, J., Uhr, C. and Frykmer, T., 2016. A complexity framework for studying disaster response management. *Journal of Contingencies and Crisis Management*, 24 (3), 124-135.
- Berlin, J. M. and Carlström, E. D., 2015. The three-level collaboration exercise—impact of learning and usefulness. *Journal of Contingencies and Crisis Management*, 23 (4), 257-265.
- Bharma, R., Dani, S. and Burnard, K., 2011. Resilience: the concept, a literature review, and future directions. *International Journal of Production Research*, 49 (18), 5375-5393.
- Bigley, G. A. and Roberts, K. H., 2001. The incident command system: High-reliability organizing for complex and volatile task environments. *The Academy of Management Journal*, 44 (6), 1281-1299.
- Blackman, D., Nakanishi, H. and Benson, A. M., 2017. Disaster resilience as a complex problem: why linearity is not applicable for long-term recovery. *Technological Forecasting and Social Change*, 121, 89-98.
- Bloomberg, L. D. and Volpe, M., 2012. *Completing your qualitative dissertation: a roadmap from beginning to end*. Thousand Oaks, CA: Sage.

- Boersma, K., Comfort, L., Groenendaal, J. and Wolbers, J., 2014. Editorial: incident command systems: a dynamic tension among goals, rules and practice. *Journal of Contingencies and Crisis Management*, 22 (1), 1–4 .
- Boin, A. and Bynander, F., 2015. Explaining success and failure in crisis coordination. *Geografiska Annaler: Series A, Physical Geography*, 97 (1), 123-135.
- Borgatti, S. P. and Mehra, A., 2009. Network Analysis in the Social Sciences. *Science*, 323 (5916), 892–895.
- Borgatti, S. P. and Halgin, D. S., 2011. On network theory. *Organisation Science*, 22 (5), 1168-1181.
- Borgatti, S. P., Everett, M. G. and Johnson, J. C., 2013. *Analyzing social networks*. Thousand Oaks, CA: Sage.
- Bosher, L. and Chmutina, N., 2021. Stop going around in circles: towards a reconceptualisation of disaster risk management phases. *Disaster Prevention and Management: An International Journal*, 30 (4/5). 525-537.
- Bossong, R. and Hegemann, H., eds. 2015. European civil security governance: diversity and cooperation in crisis and disaster management. Berlin: Springer.
- Bowen, G. A., 2009. Document analysis as a qualitative research method. *Qualitative Research Journal*, 9 (2), 27-40.
- Boyer-Villemare, U., Benavente, J., Cooper, J. A. G. and Bernatchez, P., 2014. Analysis of power distribution and participation in sustainable natural hazard risk governance: a call for active participation. *Environmental Hazards-Human and Policy Dimensions*, 13 (1), 38-57.
- Braun, V. and Clarke, V., 2006. Thematic analysis. in Cooper, H., Camic, P. M., Long, D. L., Panter, A. T., Rindskopf, D. and Sher, K. J., eds. *APA handbook of research methods in psychology: research designs: quantitative, qualitative, neuropsychological, and biological*. Washington, DC: American Psychological Association, 57-71.
- Bryson, J. M. and Crosby, B. C., 2008. Failing into cross-sector collaboration successfully. in Bingham, L. and O'Leary, R., eds. *Big ideas in collaborative public management*. Armonk, N.Y: Routledge, 65-88.
- Burt, R. S., 1992. *Structural holes: the social structure of competition*. Harvard University Press.
- Burt, R. S., 2000. The network structure of social capital. *Research in Organisational Behavior*, 22 (4), 345-423.

- Butts, C. T., 2008. Social network analysis: a methodological introduction. *Asian Journal of Social Psychology*, 11 (1), 13–41.
- Byeon, J., 2005. A systems approach to entropy change in political systems. *Systems Research and Behavioral Science: The Official Journal of the International Federation for Systems Research*, 22 (3), 223-231.
- Calkins, J., 2015. Moving forward after Sendai: how countries want to use science, evidence and technology for disaster risk reduction. *PLoS Currents*, 7, 1-11.
- Callaghan, C. W., 2016. Disaster management, crowd-sourced R&D and probabilistic innovation theory: toward real time disaster response capability. *International Journal of Disaster Risk Reduction*, 17 (1), 238-250.
- Cannon-Bowers, J. A. and Salas, E., 2001. Reflections on shared cognition. *Journal of Organisational Behavior*, 22 (2), 195–202.
- Cao, G. and McHugh, M., 2005. A systemic view of change management and its conceptual underpinnings. *Systemic Practice and Action Research*, 18 (5), 475-490.
- Capps, C. and Hazen, S. E., 2002. Applying general systems theory to the strategic scanning of the environment from 2015 to 2050. *International Journal of Management*, 19 (2), 1-4.
- Cardona, O., 2004. The need for rethinking the concepts of vulnerability and risk from a holistic Perspective. In: Greg, B., George, F. and Dorothea, H., eds. *Mapping vulnerability*. London: Routledge Publishers, 36-51.
- Chen, J., Vertinsky, I., Yumagulova, L. and Park, C., 2013. Public–private partnerships for the development of disaster resilient communities. *Journal of Contingencies and Crisis Management*, 21 (3), 130-143.
- Christensen, T., Danielsen, A., Laegreid, P. and Rykkja, H., 2016. Comparing coordination structures for crisis management in six countries. *Public Administration*, 94 (2), 316-332.
- Ciurean, R. L., Schröter, D. and Glade, T., 2013. Conceptual frameworks of vulnerability assessments for natural disasters reduction. In: John, T., ed. *Approaches to disaster management: examining the implications of hazards, emergencies and disasters*. Croatia: Intech, 3-32.
- Clark-Ginsberg, G. and Blake, J., 2020. Disaster risk reduction in cities: towards a new normal. In: Chowdhoree, I. and Ghani, S., eds. *External Interventions for Disaster Risk Reduction*. Singapoer: Springer, 123-134.

- Clark, V. L. P. and Creswell, J. W., 2010. *Understanding research: a consumer's guide*. Upper Saddle River, NJ: Pearson Education.
- Coetzee, C., Van Niekerk, D. and Raju, E., 2016. Disaster resilience and complex adaptive systems theory: finding common grounds for risk reduction. *Disaster Prevention and Management*, 25 (2), 196-211.
- Coleman, J., 1990. *Foundations of social theory*. Cambridge: Harvard University Press.
- Comfort, L. K. and Hesse, J. I., 1999. *Shared risk: complex systems in seismic response*. New York, NY: Pergamon.
- Comfort, L. K. and Hesse, J. I., 2007a. Crisis management in hindsight: cognition, communication, coordination, and control. *Public Administration Review*, 67, 189-197.
- Comfort, L. K. and Hesse, J. I., 2007b. Inter-organisational design for disaster management: cognition, communication, coordination, and control. *JSEE: Spring and Summer*, 9 (1), 51-61
- Comfort, L. K. and Kapucu, N., 2006. Inter-organisational coordination in extreme events: The World Trade Centre attacks, September 11, 2001. *Natural Hazards*, 39 (2), 309-327.
- Comfort, L. K., Boin, A. and Demchak, C. C., 2010. *Designing resilience: preparing for extreme events*. Pittsburgh: University of Pittsburgh Press.
- Coppola, D. P., 2011. *Introduction to international disaster management*. 2nd edition. Butterworth-Heinemann.
- Creswell, J. W., 2014. *Research design: qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, CA: SAGE publications.
- Crossley, N., Bellotti, E., Edwards, G., Everett, M. G., Koskinen, J. and Tranmer, M., 2015. *Social network analysis for ego-nets*. Los Angeles: SAGE.
- Crowston, K., Rubleske, J. and Howison, J., 2015. Coordination theory: a ten-year retrospective. In: Zhang, P. and Galletta, D. F., eds. *Human-computer interaction and management information systems: Foundations*. Abingdon: Routledge, 134-152.
- Cutter, S. L., Burton, C. G. and Emrich, C. T., 2010. Disaster resilience indicators for benchmarking baseline conditions. *Journal of Homeland Security and Emergency Management*, 7 (1), 1-22.
- De Roo, G. and Hillier, J., 2016. *Complexity and planning: systems, assemblages and simulations*. Abingdon: Routledge.

- Dieperink, C., Hegger, D. T., Bakker, M., Kundzewicz, Z. W., Green, C. and Driessen, P. J., 2016. Recurrent governance challenges in the implementation and alignment of flood risk management strategies: a review. *Water Resources Management*, 30 (13), 4467-4481.
- Dooley, K. J., Corman, S. R., McPhee, R. D. and Kuhn, T., 2003. Modelling high resolution broadband discourse in complex adaptive systems. *Nonlinear Dynamics. Psychology and Life Sciences*, 7 (1), 61-85.
- Dwyer, A., Zoppou, C., Nielsen, O., Day, S. and Roberts, S., 2004. *Quantifying social vulnerability: a methodology for identifying those at risk to natural hazards*. Canberra City: Geoscience Australia.
- Dynes, R. R., 1994. Community emergency planning: false assumptions and inappropriate analogies. *International Journal of Mass Emergencies and Disasters*, 12 (2), 141-58.
- Dynes, R. R. and Quarantelli, E. L., 1977. *Organisational communications and decision making in crisis*. Columbus, OH: The Ohio State University, Department of Sociology Disaster Research Centre.
- Easley, D. and Kleinberg, J., 2010. *Networks, Crowds, and Markets: Reasoning about a Highly Connected World*. Cambridge: Cambridge University Press.
- Eburn, M. and Dovers, S., 2015. Learning lessons from disasters: alternatives to royal commissions and other quasi-judicial inquiries. *Australian Journal of Public Administration*, 74 (4), 495–508.
- Eisenhardt, K. M., 2017. Organisational complexity and computation. In: Baum, J., ed. *The Blackwell companion to organisations*. Hoboken, NJ: Blackwell Publishers, 442-466.
- Eller, W., Gerber, B. J. and Branch, L. E., 2015. Voluntary nonprofit organisations and disaster management: identifying the nature of inter-sector coordination and collaboration in disaster service assistance provision. *Risk, Hazards & Crisis in Public Policy*, 6 (2), 223-238.
- Epstein, J. M. and Axtell, R. L., 1996. *Growing artificial societies: social sciences from the bottom up*. Washington, DC: Brookings Institution Press.
- Etikan, I. and Bala, K., 2017. Sampling and sampling methods. *Biometrics and Biostatistics International Journal*, 5 (6), 215-217.
- Faraj, S. and Xiao, Y., 2006. Coordination in fast-response organisations. *Management Science*, 52 (8), 1155–1189.

- Fath, B. D., Dean, C. A. and Katzmaier, H., 2015. Navigating the adaptive cycle: an approach to managing the resilience of social systems. *Ecology and Society*, 20 (2), 24-33.
- Federal Emergency Management Agency (FEMA), 1996. *Guide for All-Hazard Emergency Operations Planning*. Available from: <https://www.fema.gov/pdf/plan/slg101.pdf> [Accessed 28th Sept 2020].
- Feldman, M. S., 2004. Resources in emerging structures and processes of change. *Organisation Science*, 15 (3), 295–309.
- Feldman, M. S., 2000. Organisational routines as a source of continuous change. *Organisation Science*, 11 (6), 611–629.
- Fioretti, G. and Visser. B., 2004. A cognitive interpretation of organisational complexity. *Emergence, Complexity & Organisations*, 6 (1), 11-23.
- Folke, C., Hahn, T., Olsson, P. and Norberg, J., 2005. Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources*, 30, 441-473.
- Foster, J., 2005. From simplistic to complex systems in economics. *Cambridge Journal of Economics*, 29 (6), 873-892.
- Foster, L. A., Wiewiora, A., Chang, A. and Tywoniak, S., 2015. *How does complex adaptive system theory inform innovation in complex project based organisations?* Brisbane: Queensland University.
- Fountain, J. E., 2001. *Building the virtual state: information technology and institutional change*. Washington, DC: Brookings Institution.
- Freeman, L. C., 2004. *The development of social network analysis: a study in the sociology of science*. Vancouver, BC: Empirical Press.
- Friday, D., Ryan, S., Sridharan, R. and Collins, D., 2018. Collaborative risk management: a systematic literature review. *International Journal of Physical Distribution & Logistics Management*, 48 (3), 231-253.
- Fritz, H., Blount, C., Albusaidi, F. and Hamoud, M. A. A., 2010. Cyclone Gonu Storm Surge in the Gulf of Oman. In: Charabi, Y., ed. *Indian ocean tropical cyclones and climate change*. Berlin: Springer, 255-263.
- Gall, M., Cutter, S. L. and Nguyen, K., 2014. *Governance in disaster risk management (IRDR AIRDR Publication No. 3)*. Beijing: Integrated Research on Disaster Risk.
- Gazley, B., 2008. Beyond the contract: the scope and nature of informal government-nonprofit partnerships. *Public Administration Review*, 68 (1), 141–154.

- Gazley, B., 2008. Intersectoral collaboration and the motivation to collaborate toward an integrated theory. *In: Bingham, L. and O'Leary, H., eds. Big ideas in collaborative public management.* Armonk, N.Y: M.E. Sharpe, 46-64.
- Gentles, S. J., Charles, C., Ploeg, J. and McKibbin, K. A., 2015. Sampling in qualitative research: insights from an overview of the methods literature. *The Qualitative Report*, 20 (11), 1772-1789.
- Gimenez, R., Hernantes, J., Labaka, L., Hiltz, S. R. and Turoff, M., 2017. Improving the resilience of disaster management organisations through virtual communities of practice: a delphi study. *Journal of Contingencies and Crisis Management*, 25 (3), 160-170.
- Gkeredakis, E., 2014. The constitutive role of conventions in accomplishing coordination: insights from a complex contract award project. *Organisation Studies*, 35 (10), 1473–1505.
- Goldstein, B. E., 2008. Skunkworks in the embers of the Cedar fire: enhancing resilience in the aftermath of disaster. *Human Ecology*, 36 (1), 15-28.
- Goswami, R., Misra, S., Mondal, T. and Jana, R., 2018. *Social network analysis in the context of community-response to disaster.* London: SAGE Publications Ltd.
- Government of Oman, 2021. *The 10th Five-year Development Plan (citizen guide).* Oman: Ministry of Economy. Available from: <https://economy.gov.om/en/library/10th-plansum/6/> [Accessed 24 August 2022].
- Graber, A. D., 2003. *The power of communication: managing information in public organisations.* Washington: CQ Press.
- Grandori, A., 1997. An organisational assessment of interfirm coordination modes. *Organisation Studies*, 18 (3), 897–925.
- Gulati, R., Wohlgezogen, F. and Zhelyazkov, P., 2012. The two facets of collaboration: cooperation and coordination in strategic alliances. *Academy of Management Annals*, 6 (1), 531-583.
- Guntzburger, Y. and Pauchant, T. C., 2014. Complexity and ethical crisis management. *Journal of Organisational Effectiveness: People and Performance*, 1 (4), 378 – 401.
- Haddow, G. D. and Bullock, J. A., 2003. *Introduction to emergency management.* Newton, MA: Butterworth- Heinemann.
- Hagberg, A., Swart, P. and Dan, S., 2011. *NetworkX Reference Release 1.6.* Available from: <https://docplayer.net/87355553-Networkx-reference-release-1-6-aric-hagberg-dan-schulpieter-swart.html> [Accessed 24 August 2022].

- Hagberg, A., Swart, P. J. and Schult, D. A., 2008. *Exploring network structure, dynamics, and function using NetworkX*. Los Alamos, NM: Los Alamos National Lab.(LANL).
- Hanneman, R. and Riddle, M., 2005. *Introduction to social network methods*. California: University of California.
- Hashemipour, M., Stuban, S. M. F. and Dever, J. R., 2017. A community-based disaster coordination framework for effective disaster preparedness and response. *Australian Journal of Emergency Management*, 32 (2), 41-46.
- Hatch, M. J., 2018. *Organisation theory: modern, symbolic, and postmodern perspectives*. Oxford: Oxford University Press.
- Hazy, J. K. and Uhl-Bien, M., 2014. Changing the rules: the implications of complexity science for leadership research and practice. In: Day, D., ed. *The oxford handbook of leadership and organisations*. Oxford: Oxford University press, 709-731.
- Hedelin, B., Evers, M., Alkan-Olsson, J. and Jonsson, A., 2017. Participatory modelling for sustainable development: key issues derived from five cases of natural resource and disaster risk management. *Environmental Science & Policy*, 76, 185-196.
- Heinimann, H. R. and Hatfield, K., 2017. Infrastructure resilience assessment, management and governance—state and perspectives. In: Heinimann, H. R. and Hatfield, K., eds. *Resilience and Risk*. Dordrecht: Springer, 147-187.
- Hendrick, D., 2009. *Complexity theory and conflict transformation: an exploration of potential and implications*. University of Bradford: Centre for Conflict Resolution, Department of Peace Studies.
- Herdiana, H., Sari, J. F. and Whittaker, M., 2018. Intersectoral collaboration for the prevention and control of vector borne diseases to support the implementation of a global strategy: a systematic review. *PLoS ONE*, 13 (10), 1-21.
- Higginbottom, G. M. A., 2004. Sampling issues in qualitative research. *Nurse Researcher*, 12 (1), 7-19.
- Hillmann, J. and Guenther, E., 2021. Organisational resilience: a valuable construct for management research? *International Journal of Management Reviews*, 23 (1), 7-32.
- Holland, J., 1995. *Hidden order: how adaptation builds complexity*. Reading, MA: Addison Wesley Publishing Company.
- Holland, J. H., 2006. Studying complex adaptive systems. *Journal of Systems Science and Complexity*, 19, 1-8.
- Hollnagel, E. and Woods, D. D., 2006. *Joint cognitive systems: patterns in cognitive systems engineering*. CRC press.

- Hoque, M. A. A., Phinn, S., Roelfsema, C. and Childs, I., 2017. Tropical cyclone disaster management using remote sensing and spatial analysis: a review. *International journal of disaster risk reduction*, 22, 345-354.
- Howes, M., Tangney, P. and Reis, K., 2015. Towards networked governance: improving interagency communication and collaboration for disaster risk management and climate change adaptation in Australia. *Journal of Environmental Planning and Management*, 58 (5), 757-776.
- Humanitarian Accountability Partnership., 2010. *The 2010 HAP standard in accountability and quality management*. Geneva: HAP International.
- India Ministry of Earth Sciences, 2011. *Report on Cyclonic Disturbances over North Indian Ocean during 2010*. India: India Meteorological Department, p. 26.
- Inspector General of Police and Customs, 2018. *National Emergency Management Plan*. Muscat: National Committee for Civil Defense.
- Intergovernmental Panel on Climate Change, 2018. *IPCC Fifth Assessment Report*. Geneva: World Meteorological Organisation. Available from: <https://www.ipcc.ch/assessment-report/ar5/> [Accessed 27 November 2021].
- International Federation of the Red Cross and Red Crescent, 2002. *World Disasters Report 2002: Focus on Reducing Risk*. Geneva: International Federation of the Red Cross and Red Crescent.
- Jahre, M. and Jensen, L., 2010. Coordination in humanitarian logistics through clusters. *International Journal of Physical Distribution & Logistics Management*, 40 (8/9), 657-674
- Jensen, J. and Waugh, W. L., 2014. The United States' experience with the incident command system: what we think we know and what we need to know more about. *Journal of Contingencies and Crisis Management*, 22 (1), 5–17.
- Jones, E. C. and Faas, A. J., 2016. *Social network analysis of disaster response, recovery, and adaptation*. Butterworth-Heinemann.
- Jorgensen, D. L., 2015. *Participant observation. emerging trends in the social and behavioral sciences: an interdisciplinary, searchable, and linkable resource*. Hoboken, NJ: John Wiley & Son.
- Jung, K. and Song, M., 2014. *Linking emergency management networks to disaster resilience*. Denton, TX: Springer.

- Jung, K. and Park, H. W., 2016. Tracing interorganisational information networks during emergency response period: a webometric approach to the 2012 gumi chemical spill in South Korea. *Government Information Quarterly*, 33 (1), 133–141.
- Jung, K., Song, M. and Park, H. J., 2019. The dynamics of an interorganisational emergency management network: interdependent and independent risk hypotheses. *Public Administration Review*, 79 (2), 225-235.
- Kallio, H., Pietilä, A. M., Johnson, M. and Kangasniemi, M., 2016. Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. *Journal of advanced nursing*, 72 (12), 2954-2965.
- Kapucu, N., 2006a. Interagency communication networks during emergencies: boundary spanners in multiagency coordination. *The American Review of Public Administration*, 36 (2), 207–225.
- Kapucu, N., 2006b. Public-nonprofit partnerships for collective action in dynamic contexts of emergencies. *Public Administration*, 84 (1), 205-220.
- Kapucu, M., 2008. Collaborative emergency management: better community organising, better public preparedness and response. *Disasters*, 2008 (7), 239-262.
- Kapucu, N., 2009. Interorganisational coordination in complex environments of disasters: the evolution of intergovernmental disaster response systems. *Journal of Homeland Security and Emergency Management*, 6 (1), 1-29.
- Kapucu, N. and Hu, Q., 2020. *Network governance concepts, theories, and applications*. New York, NY: Routledge.
- Kapucu, N. and Garayev, V., 2016. Structure and network performance: horizontal and vertical networks in emergency management. *Administration & Society*, 48 (8), 931-961.
- Kapucu, N., Augustin, M. E. and Garayev, V., 2009. Interstate partnerships in emergency management: emergency management assistance compacts in response to catastrophic disaster. *Public Administration Review*, 69 (2), 297–313.
- Kapucu, N., Garayev, V. and Wang, X., 2013. Sustaining network in emergency management: a study of U.S. counties. *Public Performance & Management Review*, 37 (1), 104-133.
- Kauffman, S. A., 1993. *The origins of order: self-organisation and selection in evolution*. New York, NY: Oxford University Press.

- Kawulich, B. B., 2005. Participant observation as a data collection method. *Forum Qualitative Social Research*, 6 (2), 1-20.
- Kaynak, R. and Tuğer, A. T., 2014. Coordination and collaboration functions of disaster coordination centers for humanitarian logistics. *Procedia-Social and Behavioral Sciences*, 109, 432-437.
- Khalifa, B., 2019. The policies of the Gulf regimes in facing of the repercussions of the Arab uprisings: with application to Saudi Arabia, Kuwait, Oman, Sultanate and Bahrain. *Asian Social Science*, 15 (4), 119-127.
- Khankeh, H. R., Mohammadi, R. and Ahmadi, F., 2005. Barriers and facilitators of health care services at the time of natural disasters. *Journal of Rehabilitation*, 6 (20), 23-30.
- Kilduff, M. and Tsai. W., 2007. *Social networks and organisations*. Los Angeles, CA: SAGE.
- Kozuch, B. and Sienkiewicz-Małyjurek, K., 2016. Inter-organisational coordination for sustainable local governance: public safety management in Poland. *Sustainability*, 8 (2), 123-143.
- Lalonde, C., 2007. Crisis management and organisational development: towards the conception of a learning model in crisis management. *Organisation Development Journal*, 25 (1), 17-26.
- Lane, J. E., 2016. *Globalization—the juggernaut of the 21st century*. Abingdon: Routledge.
- Lawrence, P. R., Lorsch, J. W. J. and Garrison, S., 1967. *Organisation and environment: managing differentiation and integration*. Boston, MA: Graduate School of Business Administration, Harvard University.
- Lenoir, R., 2018. Stephen P. Borgatti, Martin G. Everett, Jeffrey C. Johnson, analysing social networks. *Lectures*, 2018, <https://doi.org/10.4000/lectures.27033>.
- Lepore, D., Montgomery, A. and Siepe, G., 2016. Managing complexity in organisations through a systemic network of projects. In: Lepore, D., ed. *Applications of systems thinking and soft operations research in managing complexity*. Cham: Springer, 35-69.
- Lichtner, W. O., 1924. *Planned control in manufacturing*. New York, NY: Ronald Publishing.
- Lincoln, Y. and Guba, E., 1985. *Naturalistic inquiry*. Thousand Oaks, CA: Sage Publications.
- Lynn, M. R., 1986. Determination and quantification of content validity. *Nursing Research*, 35 (6), 382-386.

- Magsino, S. L., 2009. *Applications of social network analysis for building community disaster resilience*. Washington, DC: The National Academic Press.
- Majchrzak, A., More, P. H. and Faraj, S., 2012. Transcending knowledge differences in cross-functional teams. *Organisation Science*, 23 (4), 951–970.
- Malone, T. W., 1988. *What is coordination theory?*. Cambridge, MA: Massachusetts Institute of Technology.
- Malone, T. W., 1987. Modeling coordination in organisations and markets. *Management Science*, 33 (10), 1317-1332.
- Malone, T. W. and Crowston, K., 1994. The interdisciplinary study of coordination. *ACM Computing Surveys*., 26, 87–119.
- Martinez, J. I. and Jarillo, J. C., 1989. The evolution of research on coordination mechanisms in multinational corporations. *Journal of International Business Studies*, 20, 489-514.
- Mason, R., 2007. The external environment's effect on management and strategy. a complexity theory approach. *Management Decision*, 45 (1), 10-28.
- McKenzie, C. and James, K., 2004. Aesthetic as an aid to understanding complex systems and decision judgement in operating complex systems. *Complexity & Organisations*, 6 (1-2), 32-39.
- McLoughlin, D., 1985. A framework for integrated emergency management. *Public Administration Review* 45, 165-172.
- Mendes, M., Gomes, C., Marques-Quinteiro, P., Lind, P. and Curren, L., 2016. Promoting learning and innovation in organisations through complexity leadership theory. *Team Performance Management*, 22 (5/6), 301-309.
- Menya, A. A. and K'Akumu, O. A., 2016. Inter-agency collaboration for fire disaster management in Nairobi City. *Journal of Urban Management*, 5 (1), 32–38.
- Miles, M. B. and Huberman, A. M., 1994. *Qualitative data analysis: an expanded sourcebook*. Thousand Oaks, CA: Sage Publications.
- Miles, J. A., 2012. *Management and organisation theory*. Los Angeles, CA: John Wiley and Sons.
- Milward, H. B. and Provan, K. G., 1998. Measuring network structure. *Public administration*, 76 (2), 387-407.
- Mitleton-Kelly, E., 2003. *Complex systems and evolutionary perspectives on organisations: the application of complexity theory to organisations*. London: Elsevier.

- Mojir, K. Y. and Pilemalm, S., 2016. Actor-centred emergency response systems: a framework for needs analysis and information systems development. *International Journal of Emergency Management*, 12 (4), 403-434.
- Moore, S. and Daniel, M., 2003. International NGOs and the role of network centrality in humanitarian aid operations: a case study of coordination during the 2000 Mozambique floods. *Disasters*, 27 (4), 305–318.
- Moreno, J., 1941. Foundations of sociometry: an introduction. sociometry. *American Sociological Association*, 4 (1), 15-35.
- Moynihan, D. P., 2008. Learning under uncertainty: networks in crisis management. *Public Administration Review*, 68 (2), 350–365.
- Munang, R., 2013. The role of ecosystem services in climate change adaptation and disaster risk reduction. *Current Opinion in Environmental Sustainability*, 5 (1), 47-52.
- NASA, 2007. *Rare Tropical Cyclone Churns in Arabian Sea*. Available from: <http://www.nasa.gov/vision/earth/lookingatearth/gonu.html> [Accessed 29 May 2021].
- National Committee for Emergency Management, 2010. *Critical Infrastructure Sector Plan..*
- National Committee for Emergency Management (NCEM), 2016. *Incident Management System*.
- National Committee for Emergency Management (NCEM), 2016. *Response Teams Guidelines*.
- National Committee for Emergency Management (NCEM), 2017. *Emergency Operations Centres Guidelines*.
- National Committee for Emergency Management (NCEM), 2017. *Sectors Emergency Management System Guideline*.
- National Committee for Emergency Management (NCEM), 2017. *Governorate Emergency Management System Guideline*.
- National Committee for Emergency Management (NCEM), 2018. The Omani National Committee for Civil Defence booklet.
- National Committee for Emergency Management (NEMP), 2018. *National Emergency Management Plan for Oman*.
- National Committee for Emergency Management (NCEM), 2021. *Cyclones that Hit Oman and their effect*.
- Noe, R. A., Hollenbeck, J. R., Gerhart, B. and Wright, P. M., 2017. *Human resource management: gaining a competitive advantage*. New York, NY: McGraw-Hill Education.

- Normandin, J. M. and Therrien, M. C., 2016. Resilience factors reconciled with complexity: the dynamics of order and disorder. *Journal of Contingencies and Crisis Management*, 24 (2), 107-118.
- Norris, F. H., Stevens, S. P., Pfefferbaum, B., Wyche, K. F. and Pfefferbaum, R. L., 2008. Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. *American Journal of Community Psychology*, 41 (1-2), 127-150.
- Northam, S. W., 2014. *The use of complex adaptive systems theory as a research model in the study of a complex policy implementations*. Chicago, IL: The Midwest Political Science Association.
- O'Leary, Z., 2014. *The essential guide to doing your research project*. Thousand Oaks, CA: SAGE Publications.
- Ohrbuch, T. L., 1997. People's accounts count: the sociology of accounts. *Annual Review of Sociology*, 23 (1), 455-478.
- Okhuysen, G. A. and Bechky, B. A., 2009. 10 Coordination in organisations: an integrative perspective. *The Academy of Management Annals*, 3 (1), 463-502.
- Olsen, W., 2004. Triangulation in social research: qualitative and quantitative method can really be mixed. In: Holborn, M., ed. *Developments in Sociology*. Ormskirk: Causeway Press, 103-118.
- Ormston, R., Spencer, L., Barnard, M. and Snape, D., 2014. The foundations of qualitative research. *Qualitative Research Practice*, 2 (7), 52-55.
- Owen, C. and Hayes, P., 2014. The challenges of change in future emergency management: conclusions and future developments. In: Owen, C. ed. *Human factors challenges in emergency management: enhancing individual and team performance in fire and emergency services*. Aldershot, Ashgate, 1-19.
- Özdamar, L. and Ertem, M. A., 2015. Models, solutions and enabling technologies in humanitarian logistics. *European Journal of Operational Research*, 244 (1), 55-65.
- Paraskevas, A., 2006. Crisis management or crisis response system? a complexity science approach to organisational crises. *Management Decision*, 44 (7), 892-907
- Parmar, S., Lobb, A., Purdin, S. and McDonnell, S., 2007. Enhancing collaboration during humanitarian response: an interim report from stakeholder's survey. *Prehospital and Disaster Medicine*, 22 (05), 414-417.
- Parsons, M., Glavac, S., Hastings, P., Marshall, G., McGregor, J., McNeill, J. and Stayner, R., 2016. Top-down assessment of disaster resilience: a conceptual framework using

- coping and adaptive capacities. *International Journal of Disaster Risk Reduction* 19, 1–11.
- Paton, D. and Johnston, D., 2017. *Disaster resilience: an integrated approach*. Springfield, IL: Charles C Thomas Publisher.
- Piñeros, J., 2020. Technocracy, disaster risk reduction and development: a critique of the sendai framework 2015-2030. *Revista Derecho Del Estado*, (47), 319-342.
- Pinto, M. B., Pinto, J. K. and Prescott, J. E., 1993. Antecedents and consequences of project team cross-functional cooperation. *Management Science*, 39 (10), 1281–1297.
- Pirasteh, S. and Li, J., 2017. *Global changes and natural disaster management: geo-information technologies*. Berlin: Springer.
- Ponomarov, S. Y. and Holcomb, M. C., 2009. Understanding the concept of supply chain resilience. *The International Journal of Logistics Management*, 20 (1), 124-143.
- Pramanik, R., Ekman, O., Hassel, H. and Tehler, H., 2015. Organisational adaptation in multi-stakeholder crisis response: an experimental study. *Journal of Contingencies and Crisis Management*, 23 (4), 234-245.
- Price, I., 2004. Complexity, complicatedness and complexity: a new science behind organisational intervention?. *Complexity & Organisations*, 6 (1-2), 40-48.
- Provan, K. G. and Kenis, P., 2008. Modes of network governance: structure, management, and effectiveness. *Journal of Public Administration Research and Theory*, 18 (2), 229-252.
- Quick, J. and Hall, S., 2015. Part three: the quantitative approach. *Journal of perioperative Practice*, 25 (10), 192-196.
- Rai, N. and Thapa, B., 2015. *A study on purposive sampling method in research*. Kathmandu: Kathmandu School of Law.
- Ramalingam, B., Jones, H., Reba, T. and Young, J., 2008. *Exploring the science of complexity: ideas and implications for development and humanitarian efforts*. London: Overseas Development Institute
- Ramos-Villagrasa, P. J., Marques-Quinteiro, P., Navarro, J. and Rico, R., 2018. Teams as complex adaptive systems: reviewing 17 years of research. *Small Group Research*, 49 (2), 135-176.
- Reagans, R., Argote, L. and Brooks, D., 2005. Individual experience and experience working together: predicting learning rates from knowing who knows what and knowing how to work together. *Management Science*, 51 (6), 869–881.

- Reilinger, R., McClusky, S., Vernant, P., Lawrence, S., Ergintav, S., Cakmak, R., Ozener, H., Kadirov, F., Guliev, I., Stepanyan, R. and Nadariya, M., 2006. GPS constraints on continental deformation in the Africa-Arabia-Eurasia continental collision zone and implications for the dynamics of plate interactions. *Journal of Geophysical Research: Solid Earth*, 111 (B5).
- Rhodes, R. A. W., 1988. *Beyond Westminster and Whitehall*. London: Unwin-Hyman.
- Rico, R., Sanchez-Manzanares, M., Gil, F. and Gibson, C., 2008. Team implicit coordination processes: a team knowledge-based approach. *Academy of Management Review*, 33 (1), 163–184.
- Ritchie, J., Lewis, J., Nicholls, C. M. and Ormston, R., 2013. *Qualitative research practice. a guide for social science students and researchers*. Thousand Oaks, CA: SAGE Publications Ltd.
- Rizzo, A., 2018. Disaster management in the inner areas: a window of opportunity for national strategy (SNAI). In: Rizzo, A., ed. *International symposium on new metropolitan perspectives*. Cham: Springer, 13-21.
- Robinson, S. E., Eller, E. S., Gall, M. and Gerber, B. G., 2013. The core and periphery of Emergency Management Network. *Public Management Review*. 15 (3), 344-362.
- Rodriguez, J. K., Holvino, E., Fletcher, J. K. and Nkomo, S. M., 2016. The theory and praxis of intersectionality in work and organisations: where do we go from here?. *Gender, Work & Organisation*, 23 (3), 201-222.
- Rydin, Y. and Tate, L., 2016. *Actor networks of planning: exploring the influence of actor network theory*. Abingdon: Routledge.
- Saldana, J., 2015. *The coding manual for qualitative researchers*. Arizona State University, USA:Sage.
- Samaratunge, R., Coghill, K. and Herath, H. M., 2012. Governance in sri lanka: lessons from post-tsunami rebuilding. *South Asia-Journal of South Asian Studies*, 35 (2), 381-407.
- Saunders, M. N. K. and Lewis, P., 2012. *Doing your research project*. Harlow: FT Prentice Hall.
- Schedler, A., Larry, D. and Marc, F., 1999. *The self-retaining state: power and accountability in new democracies*. Boulder, CO: Lynne Rienner Publishers.
- Scheidegger, A. E., 1997. Complexity theory of natural disasters: boundaries of self-structured domains. *Natural Hazards*. 16, 103–112.
- Schilling, M. A., 2000. Toward a general modular systems theory and its application to interfirm product modularity. *Academy of Management Review*, 25 (2), 312-334.

- Schneider, S. K., 1995. *Flirting with disaster: public management in crisis situations*. Armonk, NY: M.E. Sharpe.
- Scott, J. P., 2000. *Social network analysis: a handbook*. Thousand Oaks, CA: Sage Publications.
- Seeger, M. W., Sellow, T. L. and Ulmer, R. R., 2003. *Communication and organisational crisis*. Westport, CT: Praeger.
- Sharma, G., 2017. Pros and cons of different sampling techniques. *International Journal of Applied Research*, 3 (7), 749-752
- Sherif, K., 2006. An adaptive strategy for managing knowledge in organisations. *Journal of Knowledge Management*, 10 (4), 72-80.
- Sievers, J. A., 2015. Embracing crowdsourcing: a strategy for state and local governments approaching “whole community” emergency planning. *State and Local Government Review*, 47 (1), 57–67.
- Sikula, N. R., Mancillas, J. W., Linkov, I. and McDonagh, J. A., 2015. Risk management is not enough: a conceptual model for resilience and adaptation-based vulnerability assessments. *Environment Systems and Decisions*, 35 (2), 219-228.
- Silver, C. and Lewins, A., 2014. *Using software in qualitative research: a step-by-step guide*. Thousand Oaks, CA: SAGE Publications.
- Sitas, N., Reyers, B., Cundill, G., Prozesky, H. E., Nel, J. L. and Esler, K. J., 2016. Fostering collaboration for knowledge and action in disaster management in South Africa. *Current Opinion in Environmental Sustainability*, 19, 94-102.
- Smith, O., 2019. *The angry earth; disaster in anthropological perspective*. Routledge publisher.
- Solecki, W., Leichenko, R. and O’Brien, K., 2011. Climate change adaptation strategies and disaster risk reduction in cities: connections, contentions, and synergies. *Current Opinion in Environmental Sustainability*, 3 (3), 135–141.
- Stacey, R. D., 1996. *Complexity and creativity in organisations*. San Francisco, CA: Berrett Koehler Publishers.
- Strauss, A. and Corbin, J., 1998. *Basics of qualitative research*. 2nd edition. Newbury Park, CA: Sage.
- Styhre, A., 2002. Non-linear change in organisations: organisation change management informed by complexity theory. *Leadership & Organisation Development Journal*, 23 (6), 21-32.

- Sutton, J. and Austin, Z., 2015. Qualitative research: data collection, analysis, and management. *The Canadian Journal of Hospital Pharmacy*, 68 (3), 226-231.
- Tajfel, H., 1972. Social categorization. English manuscript of Lacatégorisation sociale. In: Moscovici, S., ed.. *Introduction à la Psychologie Sociale*. Paris: Larousse, 272–302.
- Tatham, P., Spens, K. and Kovács, G., 2017. The humanitarian common logistic operating picture: a solution to the inter-agency coordination challenge. *Disasters*, 41 (1), 77-100.
- Taylor, S. J., Bogdan, R. and DeVault, M., 2015. *Introduction to qualitative research methods: a guidebook and resource*. Hoboken, NJ: John Wiley & Sons.
- Teherani, A., Martimianakis, T., Stenfors-Hayes, T., Wadhwa, A. and Varpio, L., 2015. Choosing a qualitative research approach. *Journal of graduate medical education*, 7 (4), 669.
- The National Disaster Management Agency, 2017. *Swaziland El nino drought emergency response multi sectoral coordination framework*. Mbabane: United Nations Swaziland.
- Therrien, M., Normandin, J. and Denis, J., 2017. Bridging complexity theory and resilience to develop surge capacity in health systems. *Journal of Health Organisation and Management*, 31 (1), 96-109.
- Thomalla, F., Downing, T., Spanger-Siegfried, M., Han, G. and Rockström, J., 2006. Reducing hazard vulnerability: towards a common approach between disaster risk reduction and climate adaptation. *Disasters*, 30 (1), 39–48.
- Thomas, D. R. and Hodges, I., 2010. *Designing and planning your research project: core skills for social and health researchers*. Thousand Oaks, CA: Sage Publications.
- Thomasson, A., 2019. *Categories*. The Stanford Encyclopedia of Philosophy. Metaphysics Research Lab, Stanford University. Available from: <https://plato.stanford.edu/entries/categories/> [Accessed 24 November 2021].
- Thorne, S., 2016. *Interpretive description: qualitative research for applied practice*. Abingdon: Routledge.
- Tierney, K. and Bruneau, M., 2007. Conceptualizing and measuring resilience: A key to disaster loss reduction. *TR News*, 250, 14-17.
- Tompkins, E. L., Lemos, M. C. and Boyd, E., 2008. A less disastrous disaster: managing response to climate-driven hazards in the Cayman Islands and NE Brazil. *Global Environmental Change-Human and Policy Dimensions*, 18 (4), 736-745.

- Tracey, L. O'S. and Kuziemsky, C., 2013. Unraveling the complexities of disaster management: a framework for critical social infrastructure to promote population health and resilience. *Social Science & Medicine*, 93, 238-246.
- Twigg, J. and Bottomley, H., 2011. *Disaster risk reduction ngo inter-agency group learning*. London: DFID NGO inter-agency group.
- Uhr, C., 2009. *Multi-organisational emergency response management – a framework for further development*. Thesis (PhD). Lund University Centre for Risk Assessment and Management. Available from: <https://lup.lub.lu.se/search/ws/files/6165800/1435369.pdf> [Accessed June 8 2023].
- UNDRR, 2019. *Indicators of Progress: Guidance on Measuring the Reduction of Disaster Risks*. Available at: https://www.preventionweb.net/files/2259_IndicatorsofProgressHFA.pdf [Accessed 23 May 2019].
- UNDRR, 2022. *Sendai Framework 7th Anniversary: Disasters do not Need to Devastate - 2022 is a Year to Change Course*. Available from: <https://www.undrr.org/news/sendai-framework-7th-anniversary-disasters-do-not-need-devastate-2022-year-change-course-0> [Accessed 16 November 2022].
- United Nations International Strategy for Disaster Reduction, 2017. *United Nations Plan of Action on Disaster Risk Reduction for Resilience. In Support of the Sendai Framework for Disaster Risk Reduction 2015-2030*. Available from: https://www.preventionweb.net/files/49076_unplanofaction.pdf [Accessed 19 August 2021].
- United Nations International Strategy for Disaster Reduction, 2005. *Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters*. Available from: http://www.unisdr.org/files/1037hyogoframeworkforaction_english.pdf. [Accessed April 2019].
- United Nations Office for Disaster Risk Reduction, 2015. *Sendai framework for disaster risk reduction 2015 – 2030*. Geneva: Information Press. Available from: <https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030> [Accessed November 12 2023].
- United Nations International Strategy for Disaster Reduction, 2015. *Sendai framework for disaster risk reduction 2015–2030*. Available from: http://www.wcdrr.org/uploads/Sendai_Framework_for_Disaster_Risk_Reduction_2015-2030.pdf [Accessed Apr 2019].
- Urry, J., 2005. The complexity turn. *Theory, Culture & Society*, 22 (5), 1-14.

- Van Der Vegt, G. S., Essens, P., Wahlström, M. and George, G., 2015. Managing risk and resilience. *Academy of Management Journal*, 58 (4), 971–980.
- Varda, D. M., Forgette, R., Banks, D. and Contractor, N., 2009. Social network methodology in the study of disasters: issues and insights prompted by post-Katrina research. *Population Research and Policy Review*, 28 (1), 11–29.
- Vestergren, S. B., 2011. *Emergency Response Systems: Concepts, Features, Evaluation and Design*. CARER. Available at: <http://liu.diva-portal.org/smash/get/diva2:507142/FULLTEXT01.pdf> [Accessed 19 Nov 2020].
- Vvon, L., Beakley, J. E. and Patricelli, F., 2008. Disaster management: the structure, function, and significance of network-centric operations. *Journal of Homeland Security and Emergency Management*, 5 (1) 42-53.
- Walker, B., Holling, C. S., Carpenter, S. R. and Kinzig, A., 2004. Resilience, adaptability and transformability in social-ecological systems. *Ecology and Society*, 9 (2), 5-14.
- Wasserman, S. and Faust, K., 1994. *Social network analysis: methods and applications*. Cambridge: Cambridge University Press.
- Waugh, W. L. and Streib, G., 2006. Collaboration and leadership for effective emergency management. *Public Administration Review*, 66, 131-140.
- Weichselgartner, J., 2001. Disaster mitigation: the concept of vulnerability revisited. *Disaster Prevention and Management*, 10 (2), 85-95.
- Weichselgartner, J. and Pigeon, P., 2015. The role of knowledge in disaster risk reduction. *International Journal of Disaster Risk Science*, 6, 107–116.
- Weick, K. E. and Sutcliffe, K. M., 2007. *Managing the unexpected: resilient performance in an age of uncertainty*. San Francisco, CA: John Wiley and Sons.
- White, L., 2000. Changing the “whole system” in the public sector. *Journal of Organisational Change Management*, 13 (2), 162-177.
- White, P., Pelling, M., Sen, K., Seddon, D., Russell, S. and Few, R., 2004. *Disaster risk reduction- a development concern*. Norwich: University of East Anglia.
- Wilson, J. M., O’Leary, M. B., Metiu, A. and Jett, Q. R., 2008. Perceived proximity in virtual work: explaining the paradox of far-but-close. *Organisation Studies*, 29 (7), 979–1002.
- Wolbers, J., Boersma, K. and Groenewegen, P., 2018. Coordination theories are characterized primarily by a focus on integration, in which coordination is aimed at achieving a coherent and unified set of actions. *Organisation Studies*, 39 (11), 1521–1546.

World Atlas, 2023. *Map of Oman*. Available from: <https://www.worldatlas.com/maps/oman>
[Accessed March 23 2023].

World Health Organisation, 2020. *Multisectoral preparedness coordination framework*.
Geneva: World Health Organisation. Available at: <https://www.who.int/publications-detail-redirect/9789240006232> [Accessed 23 June, 2022].

World Health Organisation, 1998. *Health Promotion Glossary. WHO/HPR/HEP/98.1*.
Geneva: World Health Organisation. Available at:
<https://www.who.int/healthpromotion/about/HPR%20Glossary%201998.pdf> [Accessed 23
June, 2019].

Appendix 1: Thesis Findings Summary Table

Lenses			Response Network	Risk Reduction Network
Governance	<p>Legitimacy</p> <p>Is network capable of gaining internal and external acceptance and recognition as a legitimate form of organization??</p> <p>Institutionalizing network structure and systems</p>	<p>Foundation administrative order/law (Clear role and functions).</p>	<p>CDL 76/91 establishes NCEM and identify its roles and responsibilities in disaster management including preparedness, risk reduction (prevention and mitigation), response, and recovery.</p> <p>NCEM emergency response roles include:</p> <ul style="list-style-type: none"> ▪ Develop a national emergency response plan and structure. ▪ create EM entities (at national, governorate, and local levels) ▪ Identify roles and responsibilities of various government departments. ▪ Enhance public and community response capacity and resources. ▪ Mobilize resources and coordinate joint response actions. ▪ Command and control response and recovery operations. 	<p>Yes. CDL 76/91 establishes NCEM and identify its roles and responsibilities in disaster management including preparedness, risk reduction (prevention and mitigation), response, and recovery.</p> <p>NCEM risk reduction roles to include:</p> <ul style="list-style-type: none"> ▪ Develop a risk reduction strategy and execution plan. <ul style="list-style-type: none"> ▪ Enhancing risk reduction legislations. ▪ Coordinate joint risk reduction actions among relevant authorities. ▪ Overall supervision of the enforcement of risk reduction laws. ▪ Propose solution to the government to resolve risk reduction challenges.
		<p>NW Strategy with common vision and goals</p>	<p>NCEM strategy identify common vision, mission, goals, objectives, and KPIs.</p>	<p>There is no specific risk reduction strategy. NCEM's strategy focus on enhancing readiness and response capabilities. With</p>

			limited attention toward risk reduction.	
		Network structure/Framework	<p>NEMP (approved by the Sultan and the Cabinet of Ministers and endorsed by the NCEM chairmen) identify EM doctrine, EMS structure including response framework and command and control structure, roles and responsibilities and other administrative systems. The Omani EMS consist of the NCEM, its NEM Centre, 8 sectors, 11 GEMs, and 61 WSDCs.</p>	<p>NEMP specify risk reduction principles and general responsibilities, each organisations' RR related roles, responsibilities, and expectations. According to the NEMP, Risk reduction should be coordinated by the EW sector which include members representing various risk owner ministries. In addition, other sectors, along with GEMCs are tasked with risk reduction responsibilities. However, none of this is practiced.</p>
		social identity and public presence	<p>Distinct social identity with very active public outreach program that is associated mostly with emergency response.</p>	<p>Social identity is not correlated with risk reduction as focus of NCEM' public outreach program is on preparedness activities and response efforts.</p>
		Authority/legitimacy to conduct transactions	<p>NCEM is mandated by law and administrative systems to establish and institutionalize the emergency management system in Oman. This includes the authority to develop EM response plans, issues warnings, evacuate people, leverage public and community capacity and resources, synthesis priorities, and coordinate joint actions and integrating resources to prepare for</p>	<p>While NCEM is mandated by CDL and other laws to enhance risk reduction and it is officially authorized for this purpose to supervise the development and enforcement of risk reduction bylaws and coordinate the implementation of risk reduction measures, yet NCEM seems to be reluctant to instigate this role nor its accompanying authority. Reasons for this reluctance might be</p>

			or respond to an emergency.	linked to the fact that risk reduction measures are integral part of line ministries duties thus avoiding interfering with Ministers plans and projects. Too, RR measures are planned for and financed by a higher authority (Council of Ministers).
		Access to funds, resources, and competencies	NCEM is authorized to utilizes available public, private, NGOs resources and competencies to prepare for and respond to major emergencies. However, NCEM does not have its own budget. For example, being attached to the Royal Oman Police (ROP), NEM Centre' expenses (including staff and other admin expenses) are covered by the ROP. Unlike other government entities, NCEM is not a financially independent government department. It does not have a dedicated annual budget which it can use to finance various capacity building projects including training and exercise. In fact, the only full-time staff that are dedicated to the pursue NCEM goals are the NEM Centre staff. All others involved in the EM system carry such roles in addition to their day-to-day jobs (without additional payment or	Risk reduction projects are executed by line ministries with dedicated budgets and financial support from the government. As NCEM risk reduction roles are limited to enhancing RR legislations, coordinating joint risk reduction actions among relevant authorities, it is not provided with a dedicated risk reduction funds/budgets needed.

			<p>other increment) this includes sector and GEMCs coordinators. This is one of the major weaknesses hindering NCEM from institutionalizing and enhancing the EM system.</p>	
		<p>Social capital (Community support & other network engagement)</p>	<p>Response network efforts gain wide support from community both by direct participation in network efforts as volunteers, or by the provision of donations, in addition to the support gain form the private sector and NGOs.</p>	<p>While risk reduction activities carried out independently by line ministries get some kind of support by the community, such efforts or projects are not executed as a product of a collaborative network, rather as institutional efforts and initiatives.</p>
			<p>Acting within preestablished scope of conduct and fully mandated network with a legal system and policy documents, the response network is widely recognized both by the government, member organisations, and the public as the legitimate official response network.</p>	<p>While NCEM is mandated by laws to enhance risk reduction, it has not been fulfilling this role. As there is no consensus among interviewees that NCEM is in charge of risk reduction responsibilities, NCEM legitimacy is very limited compared to its legitimacy as a response authority.</p>
Accountability		<p>External accountability</p>	<p>Oman response networks is having a solid accountability system. External accountability is evident in the form of laws, policies, mandates, administrative regulations and bylaws, and bureaucratic checks and balances. The response network is accountable to the</p>	<p>The NEMP includes risk reduction objectives along with roles and responsibilities assigned to the various ministries and agencies, such objectives and responsibilities are not implemented or coordinated by the NEMC. Interviews indicate that primary risk mitigation</p>

			government and the public.	measures are carried out by risk owner ministries without the direct involvement of the NCEM.
		Internal accountability	Internal accountability external accountability is evident in the form of network policies and governance system, roles, responsibilities, expectations, administrative system policies, structure, auditing mechanisms, including professional performance assessment system. Response network member organisations are accountable to the NCEM.	As such risk reduction in Oman is the sum of all public and private sector organisations working either unilaterally, bilaterally or multilaterally together on disaster risk reduction issues, these organisations are independently accountable to the government and the public for carrying their mandated risk reduction responsibilities according to the roles and responsibilities assigned to them by the law.
Leadership & Management	Governance Structure/Forum	ROP assumes the role of the lead agency in the Omani emergency management system including the response network. The NEM Center is staffed and managed by ROP officers.	While ROP is the leads agency of the emergency management system in Oman, unlike its leadership roles in the response network, risk reduction network is in active. Thus, in reality, each risk owner organisation leads its risk reduction projects and issues unilaterally, bilaterally or multilaterally with other organisations. There is no central coordinator who leads, manages, or integrates risk reduction efforts. Risk reduction is performed similar as pre-2010 system, that is the institution-based system without central	
	Leadership Style and Practices	ROP works toward enhancing relationships with response network members and stakeholders by integrating and aligning their diverse goals and expectations with network goals and mission. NCEM adopts a facilitative and		

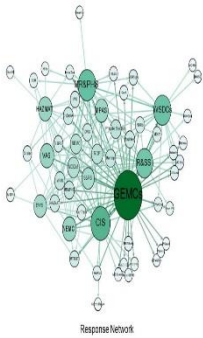
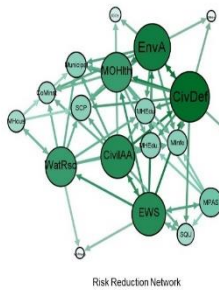
			<p>inclusive management approach. Its Leadership promote & foster collaboration build and enhance relationships, establish rules, and build consensus on collaborative goals. ensure trust and commitment from network members.</p> <p>NEMC is active on behalf of the NCEM in connecting various components of the system, enhance and facilitate cross sector collaboration and cooperation, and ensure members are working collectively toward achieving the common goals of the network, and that they are responsible for performing their roles, etc.</p>	<p>coordination and clear leadership.</p>
<p>Collaborative Functions</p> <p>integrated activities</p> <p>Network Member active engagement and high trust</p>	<p>Coordination System</p>	<p>Coordination System/structure</p>	<p>The Response Network coordination structure consist of:</p> <ul style="list-style-type: none"> ▪ NCEM: the strategic collaborative forum at the national Level. ▪ NEM Coordinator ▪ Sectors Coordinators at the national and GOV levels. ▪ Primary & support agencies Focal Points ▪ GEMCs Coordinators 	<p>The risk reduction Network coordination structure should consist of:</p> <ul style="list-style-type: none"> ▪ NCEM: the strategic collaborative forum at the national Level. ▪ NEM Coordinator ▪ EW Sector Coordinator ▪ Sectors Coordinators at the national and GOV levels. ▪ Primary & support agencies Focal Points.

			<ul style="list-style-type: none"> ▪ Incident Coordinator/Commander 	<ul style="list-style-type: none"> ▪ GEMCs Coordinators. ▪ WDCs Coordinators <p>However, EWS has not been active in coordinating risk reduction efforts and activities; thus, risk reduction is devolved by line ministries. The Civil Aviation Authority coordinates metrological and tsunamis risk reduction efforts. Similarly, the DG of Water Resources leads and coordinates floods risk reduction. The Ministry of Health coordinates health-related risk reduction programs. The HAZMAT & oil pollution Risk Reduction efforts are led and coordinated by the Environment Authority</p>
Collaborative functions	Standardization & Planning	<p>NEMP details of the appropriate actions to be taken before, during and after disasters, EMS doctrine, command-and-control structure, roles and responsibilities of different entities in response to emergencies. It provides the foundation for the development and implementation of the other Plans.</p> <p>Standardization: NEMC developed the response framework</p>	<p>interviewees are not aware of any national risk reduction strategy.</p> <p>risk reduction plans are developed by each risk owner in conjunction with the Supreme Council for Planning in formal planning meetings. the development of financial instruments is done at special meetings with the Cabinet office and the Ministry of Finance. Thus. There is no national wide risk reduction strategies or</p>	

			and the Incident Management system (IMS) which is a standardized hierarchical structure that allows for a cooperative response by multiple organisations to organize and coordinate response	integrated risk reduction planning.
		Capacity Building	Strengthening the institutional and organisational structure of the disaster management system, staffing, and resources and funding of training programs and regular drills for the emergency operations centers' staff, Sectors, and GEMCS. This include strengthening the disaster response force; setting up joint decision support systems, and standard emergency operation centres to integrate and analyse information from multiple sources in an integrated geo-spatial system	Risk reduction capacity building projects are done independently by each risk owner without the involvement of a collaborative leadership that connects various components of the RR system, enhance and facilitate cross sector collaboration and cooperation, and ensure members are working collectively toward achieving the common RR goals.
		Information sharing	there is a well-established system of reporting and information-sharing among various participating agencies. However, the criticism is that the system is not yet automated. Not all response organisations have communication systems.	Several officials form of risk owners' organisations assert that in their organisations' effort to conduct risk analysis for the risks with their scope, they were not able to obtain the necessary information form relevant ministries/organisations . They uphold that risk reduction information sharing is very limited

			<p>and had the NCEM being active in risk reduction, such information would have been provided easily if requested by the NCEM</p> <p>the publication of information on risk analysis and risk mitigation. is not performed yet. Unlike many countries where risk reduction authorities would make available to the public,</p>
		<p>Resource Sharing</p>	<p>primary and support organisation are mandated by law to provide expertise, resources and capabilities necessary to support and assist in response efforts. Resource sharing is well practiced during emergency response.</p> <p>Limited resource sharing mechanisms by which collective risk reduction efforts and resources are coordinated and implemented. An example of this is risk assessments. While some organisations have risk analysis expertise and methodology, other don't have such capabilities. Such valuable yet unavailable resources could be shared in carrying out popper risk analysis reports that can benefit the whole system</p>
		<p>Joint Actions</p>	<p>sectors are mandated to outline specific tasks or functions that may be carried out before, during, and after an emergency or a disaster. Too, they are mandated to ensure that their response teams are structured and function according to</p> <p>While there are extensive risk mitigation efforts carried out be risk owners, such efforts are not coordinated nor well planned for to address the country disaster management needs and requirements. Rather such efforts are done</p>

			the IMS, and that they are well trained on IMS.	independently form the knowledge of the NCEM (NCEM is not nor informed).It can be speculated that risk reduction collaboration joint actions as cross sector risk assessments including various stakeholders and member organisations is very limited.
Network Structure		Density (connectedness)	0.06, which is very low, suggesting network is quite sparse/ low connectedness,	~0.187, meaning that only 18.7 % of all the possible relationships between members of risk reduction network were established. It indicates that the actual tie among risk reduction organisations is very limited suggesting low connectedness,
		Centralization (cohesiveness)	<p>The overall degree of centralization is 12%.</p> <p><u>GEMCs</u> has the highest degree centrality and can be regarded as the most influential in the response network.</p> <p>This suggests the amount of collaboration and cooperation, connectivity, and communication GEMCs play as incident coordinators and as source of information in the response network, something that is corroborated by majority of interviewees.</p>	<p>The overall degree of centralization is 15.4%.</p> <p>The degree of centralization value indicate that a large number of organisations were not in communication with other organisations.</p>

		<p>boundary spanners/brokers</p>	 <p>Response Network</p> <p>central organisations in the network such as GEMCs, CIS, MR&PHS, NEMC, WSDCs and R&SS.</p>	<p>are certain central organisations in the network such as CivDef, EnvA, EWS, CivilAA and WatRsc.</p>  <p>Risk Reduction Network</p>
--	--	---	--	--

Appendix 2: Interview Questions

General Background Questions

Sampling Criteria Question:

M_____ F_____

Rank in the Organisation?

- Senior Management
- Middle Management
- Staff

How Long have you been working in your current job?

- 0-3
- 3-6
- 6-10
- Over 10

You are from:

- | | | |
|---|-----------------------------------|-----------------------------------|
| <input type="checkbox"/> Public (civil) | <input type="checkbox"/> National | <input type="checkbox"/> Regional |
| <input type="checkbox"/> Military | <input type="checkbox"/> National | <input type="checkbox"/> Regional |
| <input type="checkbox"/> Private | <input type="checkbox"/> National | <input type="checkbox"/> Regional |
| <input type="checkbox"/> NGO | <input type="checkbox"/> National | <input type="checkbox"/> Regional |

Educational level?

- Primary School Graduate
- High School Graduate
- College Graduate

Do you have any professional qualification in the disaster management field?

- No
- Diploma Level
- Degree Level
- Post-Graduate Degree Level

What do you perceive as your primary role in the DMS?

- Policy Maker
- Response Coordinator
- Disaster reduction practitioner
- Agency Representative/Focal Point
- Advisor
- Other

How long have you been in this capacity in relation to disaster management?

- 0-3
- 3-6
- 6-10
- Over 10

Did you participate in response to any of the last three major disasters in Oman?

- No
- Yes

Oman Emergency Management System

1. Can you describe the EMS in Oman?
2. What is your organisation's role in NDMS (during risk reduction phase and response phase)? What is your role?
3. What do you perceive to be the most likely hazards confronting Oman today?
4. What is the risk reduction/response approach in Oman??
5. Which organisation is responsible for (i.e., leads) Risk Reduction/response in Oman?

Network Governance

1. Are you aware of any strategies and plans that have been developed to reduce disaster risk in Oman? What are they?
2. How are roles and responsibilities for disaster risk reduction/response assigned?
3. What risk reduction/response administrative system policies, structure, auditing mechanisms exist?
4. How clear is command control structure in the Omani EMS, and what are the challenges and unclarities in this regard?
5. Which organisations in Oman in your view drive and lead disaster reduction/response strategies and plans in practice? Do you work closely with them and how? If not why not?

Network Collaborative Functions

1. Can you Explain the coordination structure and coordination system in the risk reduction phase and response phase?
2. Which organisations is responsible for (i.e. leads) intersectoral risk reduction/response coordination in Oman?
3. Which coordination mechanisms do they (most) use in disaster reduction/response in Oman?
4. How intensive is this coordination/collaboration during DR/response?
5. What type of agreements on institutional, administrative and operational dimensions exist in your sector and among other sectors in disaster reduction/response?
6. What are the coordination mechanisms used in resource sharing and mutual aid and providing support: determining priority need and gaps in assistance?
7. Is there a publication that clearly provides an overview of the roles and inter-relationships of the sectors that could facilitate common understanding among all sectors and participating organisations?
8. How effective is coordination in planning and decision-making during risk reduction?
9. How are decisions on mitigation activities/measures made, executed, and assessed??
10. How are risks identified and expressed? – reports, database, maps, GIS, etc?
11. How information sharing and knowledge management is regulated and practiced in risk reduction/response?
12. Is there a common communications system/platform for risk reduction/response? How is communication interoperability achieved?

13. How task integration be achieved in risk reduction/response? What reforms would you like to see/suggest?
14. What are the strengths and weaknesses of the current coordination mechanisms used in disaster risk reduction/response in?
15. Are there any issues that might hinder effective coordination in Oman?
16. How can coordination/collaboration be improved in Oman??

Network Characteristics

1. Identify organisations/sectors they considered most influential in the emergency management system and identify organisations/sectors they directly engage in risk reduction activities.
2. Which sectors/ agencies do you have more coordination/collaboration with during disaster risk reduction? And why?
3. Which sectors/ agencies do you depend on more/trust to work with during risk reduction? why?

Risk Reduction Network Vs. Response Network

1. Do you see there to be differences in the sectors and agencies that you work with during risk reduction compared to response? If yes, why? If not, why not?
2. Do you see there is a difference in the kinds of co-ordination mechanisms used in disaster response compared to disaster risk reduction? If yes, why? If not, why not

Appendix 3: Transcript of one of the Interviews Conducted

CODE #: XYZ

General Background Questions

Sampling Criteria Question:

M F

Rank in the Organisation?

- Senior Management
- Middle Management
- Staff

How Long have you been working in your current job?

- 0-3
- 3-6
- 6-10
- Over 10

You are from:

- | | | |
|---|-----------------------------------|-----------------------------------|
| <input type="checkbox"/> Public (civil) | <input type="checkbox"/> National | <input type="checkbox"/> Regional |
| <input type="checkbox"/> Military | <input type="checkbox"/> National | <input type="checkbox"/> Regional |
| <input type="checkbox"/> Private | <input type="checkbox"/> National | <input type="checkbox"/> Regional |
| <input type="checkbox"/> NGO | <input type="checkbox"/> National | <input type="checkbox"/> Regional |

Educational level?

- Primary School Graduate
- High School Graduate
- College Graduate
- Post Graduate

Do you have any professional qualification in the disaster management field?

- No
- Diploma Level
- Degree Level
- Post-Graduate Degree Level

What do you perceive as your primary role in the DMS?'

- Policy Maker
- Response Coordinator
- Disaster reduction practitioner
- Agency Representative/Focal Point
- Advisor
- Other

long have you been in this capacity in relation to disaster management?

- 0-3
- 3-6
- 6-10
- Over 10

Did you participate in response to any of the last three major disasters in Oman?

- No
- Yes

Part I: Oman Emergency Management System

1. Can you describe the EMS in Oman?

The NCEM is the overall umbrella organisation that is mandated with developing and executing disaster management plans for the country. The committee is chaired by the Police IG, and undersecretaries representing various government, military police, and NGOs. The Committee has similar structure reflected at the governorate level, called Governorate EM committees. The Omani EMS is consisting of the National EM Centre, function based sectors, and other lead and support agencies that are identified in the NEMP.

2. What is your organisation's role in NEMS (during risk reduction phase and response phase)? What is your role?

During Risk reduction phase, CIS is mandated with: An integral part of our role either as PAW or CI Sector, according to the NEM Plan, is divided into the three phases of disaster management:

- 1- Risk Reduction & Mitigation
- 2- Preparedness & Responses
- 3- Recovery.

In the risk reduction phase, we are tasked with:

- 1- Conduct risk assessments
- 2- Identify and implement risk reduction measures and procedures.
- 3- Develop and maintain business continuity plans and programs.

As a CIS coordinator, my role in DR is to make sure the above-mentioned roles are carried and efforts are coordinated among various organisations that are members of the sector in collaboration with the executive office of the NCCD.

During response phase, CIS is mandated with:

1. Activating CIS plan and CIS EOC.
2. Ensuring that information and warning is disseminated to all sector member organisations.
3. Direct member organisation/facilities to active their emergency response and business continuity plans.

4. Mobilise technical teams, spare parts, and other resource to restore critical infrastructure service including:
 - a. Roads
 - b. Electricity
 - c. Water
 - d. Communications
 - e. Sewage systems
 - f. Fuel
5. Provide CI support to other sector and agencies if needed.
6. Inform the public of the Sectors' response efforts.

My roles during response phase are to:

1. Coordinate response and information sharing among various agencies in the sector and sector branches in the Govs & Wilayats.
2. Continuously providing partner agencies and sector branches with updated forecasts and operational directives/ and other related information issued by the NEMC.
3. Coordinate with other sectors in providing any assistance needed (i.e. power generator water, communications, medical staff, transportation, security escort, etc.....)

3. What do you perceive to be the most likely hazards confronting Oman today?

Cyclones and related hydrological hazards, Cyber Attacks, industrial accidents.

4. What is the risk reduction/response approach in Oman??

Oman adopts a multi-hazard comprehensive disaster management approach. For example, the NCEM policy for risk reduction is to ensure that disaster risk reduction is a national priority with a strong institutional basis for implementation. It considers risk reduction phase an integral part of the disaster management process. Thus. It encourages the implementation of risk mitigation measures.

For response, NCEM works to ensure that Omanis ready to respond to and contain any major emergency by enhancing preparedness activities including planning, capacity building, training, exercise, etc. Extensive efforts are put to ensure that emergency response is swift, effective, and redundancy or duplication of efforts is minimised.

5. Which organisation is responsible for (i.e., leads) Risk Reduction/response in Oman?

It is the National Committee for Emergency Management. It is in the umbrella that lead and coordinates all disaster management effort in Oman especially for disaster preparedness & response. However, for structural risk reduction projects each ministry/ authority has a specific RD role. All Risk Reduction requirements are reviewed, assessed, and financed by the Supreme Council for Planning which is part of the Cabinet Office.

Part II: Network Governance

1. Are you aware of any strategies and plans that have been developed to reduce disaster risk in Oman? What are they?

I am aware that the NEM Plan issued by the NCEM includes on it DR objectives along with roles and responsibilities for various sectors and agencies. Too, there is the National Urban Planning Strategy that has some risk reduction aspects.

2. How are roles and responsibilities for disaster risk reduction/response assigned?

Response and Risk reduction roles and responsibilities are identified for various agencies in the National Emergency Management Plan according to the Civil Defence Law. However, there are certain risk reduction responsibilities that certain ministries are mandated with i.e. Ministry of Municipalities and Water Resources with regards to flood risk reduction.

During Response operation an operational directive would be issued by the NEMC, and any subsequent directives and orders issued by the NEMC.

3. How clear is command control structure in the Omani EMS, and what are the challenges and unclarities in this regard?

The National Emergency Management Plan, issued by the NCEM, clearly identifies command and control structure at the national level, Gobs Level, and Wilayat Level. Too, authority for each level is identified and enhanced by Operational Directives that are issued for each disaster.

4. Which organisations in Oman in your view drive and lead disaster reduction/response strategies and plans in practice? Do you work closely with them and how? If not why not?

The NCEM is the owner of the NEM Plan and is in charge of coordinating efforts among agencies/ministries that are mandated by law with implementing reduction measures for the risk/risks that are under their scope of speciality. The NCEM is tasked as per the Civil Defence Law issued in 91, to coordinate disaster risk reduction efforts among various ministries and gov department in collaboration with the Cabinet Office and Supreme Council for Planning. The NCEM is mandated to enforce the Civil Defence Law which requires risk reduction measures to be identified and implement according to proper risk assessment tools.

Yes, we work in coordination with the NCEM's Executive Office and other concerned gov departments. However, since risk reduction need significant capital (funds), which are usually granted by the government; thus, we (as agency not as sector) submit independently (just our DR requirements for funds directly to the cabinet in our annual budget plans. This then gets scrutinized by the Supreme Council for Planning and Ministry of Finance, which will decide whether funds will be allocated to such (DR) projects and/ or how/When. Just like any other country, there are always priorities over disaster risk reduction measures.

During Response phase, NCEM leads repone operations through its National Emergency Management Centre (NEMC). During this phase, we work very much in coordination, and collaboration with the NCEM and the NEMC. We are an active sector and an integral part of the disaster response system that NCEM directs, coordinates, and leads.

Part III: Network Collaborative Functions:

1. Can you Explain the coordination structure and coordination system in the risk reduction phase and response phase?

In general, there is the NCEM and its branches in the governorates (GEMCs) that coordinates all disaster management efforts in Oman. Then, there are sector's coordinators at the national level and governorate level that coordinate specific emergency functions within their responsibility.

2. Which coordination mechanisms do they (most) use in disaster reduction/response in Oman?

In risk reduction phase formal coordination mechanisms are used and preferred. This is due to the fact that RD issues require approval of significant funds and resources. Then, there is the compliance aspect. It is always better to have coordination in RD issues documented and formal.

However, coordination during response operations is more intensive due to the urgency of the matter. This includes meetings and joint planning at the NCEM Level, Meeting and joint planning at the Sector coordinators Level, Meeting and joint Planning at the Sector Level (national and governorate Level). These are Operational Directives issued by the NEMC, Meetings & Briefings (including conference calls), Having a representative of the Sector 24/7 at the NEMC, Activating the Sector Emergency Operation Centre (SEOC), 4/7 Direct NEMC to Sector EOC coordination and reporting., Personal communications (including phone calls), and social apps (i.e. WhatsApp) These meetings and coordination activities allow to participate and share our issues, challenges, and concern in these meetings which gives us a chance to be part of the planning and decision-making process.

3. How intensive is this coordination/collaboration during DR/response?

I think coordination is more intensive and interactive during preparedness and response phase. It is less during risk reduction phase as this phase is usually a long-term phase that do not necessarily necessitates intensive coordination like that of the response phase.

4. What type of agreements on institutional, administrative, and operational dimensions exist in your sector and among other sectors in disaster reduction/response?

Our main guiding reference in term of institutional and structural aspects in the NEM Plan. For operational aspects we refer to very emergency response plans including the CIS plan. These plans identify details related to roles and responsibilities, and expectations of each member organisation within the sector.

5. What are the coordination mechanisms used in resource sharing and mutual aid and providing support: determining priority need and gaps in assistance?

In our Sector, and I do not think this implemented in many other sectors, because we have many member organisations from the private sectors, we have developed a detailed mutual aid plan that identify which organisations will provide what resources to support collaborative response efforts carried out by the CIS.

6. Is there a publication that clearly provides an overview of the roles and inter-relationships of the sectors that could facilitate common understanding among all sectors and participating organisations?

As have explained earlier, we depend on the following documents:

- National Emergency Management Plan
- National Critical Infrastructure Plan.
- Governorate Emergency Management Plan
- Critical Infrastructure Plan at the governorate level.
- Incident Command System (Incident Response System)
- EOC Operation Guidelines.

7. How effective is coordination in planning and decision-making during risk reduction?

I believe that planning and decision making is very effective during the response phase as there are joint planning sessions, deliberation prior, during, and after each major situation, and collaboration among decision makers from various organisations. However, I cannot say the same about joint planning or collaborative decision making in the risk reduction phase as most decisions with regard to mitigation projects planning and execution are done without direct involvement from NCEM.

8. How are decisions on mitigation activities/measures made, executed, and assessed??

It has been a practice that each risk owner ministry identify mitigation requirements within its scope, submit them to the Supreme Council for Planning, which once approved get

submitted to the Council of Ministers. Once approved by and budgets is allocated, the risk owner ministry would supervise the execution of the project with the assigned contractor.

9. How are risks identified and expressed? – reports, database, maps, GIS, etc?

At the National Level, there is the county risk register that is developed by the Early Warning Sector and is included in the National Emergency Management Plan. Recently, a Risk Analysis and Horizon Scanning Working Group was established by the NCEM that is tasked with providing the NEMS with an updated (annually) overall risk assessment report. At the Sector/Agency level, each Sector/Agency is mandated with assessing risk within their jurisdictions/domain, and to use the outcome of such assessments as the basis for developing Sector/Agency emergency management plan. At the Facility level, each Facility (i.e. ports, airports, power generation facility, etc.) is mandated with assessing risk within their premises/operation, and to use the outcome of such assessments as the basis of developing their emergency management and business continuity plan.

10. How information sharing and knowledge management is regulated and practiced in risk reduction/response?

There are excellent efforts that is made by the NCEM in term of enhance information sharing among various members of the NEMS. This includes meetings, briefings, calls, official correspondences, operational directives, etc. During disasters, the NEMC call for all of us sector representatives, and other agency focal points to be present at the NEMC EOC. Too, there are continuous training programs and knowledge building activities for that have been focused on disaster response. I have participated in some workshops about risk reduction, but they are limited in number and scope. I think we focus more on response and response is a collective effort and needs continuous capacity building programs to ensure a swift and integrated reponse operations.

**11. Is there a common communications system/platform for risk reduction/response?
How is communication interoperability achieved?**

Well, this is a very good question. AS we the CIS are civil government agencies and private sector companies, we use commercial communication systems. Unlike our Military and

police organisations who are equipped with their own communication systems. Honestly, this is one of the major challenges we face in field operations. We lack communication system that can withstand harsh weather condition and that can sustain communication during disasters.

12. How task integration be achieved in risk reduction/response? What reforms would you like to see/suggest?

Task integration is achieved by having a common National Emergency Management Plan, a National Critical Infrastructure Plan, a Governorate Emergency Management Plan, and most importantly by the Incident Command System (Incident Management System) which identify how task are executed and command and control structure exist, and how operation are conducted.

13. What are the strengths and weaknesses of the current coordination mechanisms used in disaster risk reduction/response in?

strengths and weaknesses in disaster risk reduction

Strength:

1. We know whom to contact and coordinate with in each and every ministry including the executive office.
2. The Executive Office facilities and coordinate with respective ministries with regards to any RD issues.

Weaknesses:

1. It would have been more effective if there are designated meetings to discuss RD issues and challenges. Just like meeting and coordination mechanisms used in the response phase, RD issues could get the same level of attention and be addressed with the same framework.

Strengths and weaknesses in response

Strengths:

- Effective and updated information sharing.

- Various types of coordination mechanisms with predefined coordinators/ focal points.
- Roles and responsibilities are clear, and so are expectations from each sector/organisation.
- Well known Network of coordinators and focal points that make coordination easy.
- SOPs are well established and practiced.
- NEMC facilitates and eases any coordination and liaison challenges among various actors..

Weaknesses:

The lack of standalone communication systems and use of advanced technology to share information and maintain situational awareness.

14. Are there any issues that might hinder effective coordination in Oman?

Institutionalization of coordination units: the need to have official coordination units in lead agencies for each and every sector.

15. How can coordination/collaboration be improved in Oman??

Risk reduction:

I think the disaster reduction objectives, along with the roles and responsibilities identified in the NEM Plan in the RD phase should be implemented and followed by the executive Office just like the preparedness and response phase. Although the NCEM is mandated with RD issues just like preparedness and response, however; the RD phase does not get as much attention as the response issues, nor RD issues are raised and discussed in NCEM meeting or Coordinators meetings. Too, RD issues should be raised, discussed, debated, planned for, and coordinated at the Governorate Civil Defence Committees. I think we are more the NEMS/NCCD is a response-oriented system/organisation. To enhance Response there is a need for more Training and Exercises, especially in major accidents (multi causality incidents) and Having A solid IT information sharing platform. Finally, there is always a need to have permanent units in every sector with proper number of staff to ensure availability of coordination activities.

Part IV: Network Characteristics

- 1. Identify organisations/sectors they considered most influential in the emergency management system and identify organisations/sectors they directly engage in risk reduction activities and response operations.**

In the Response Phase: The National Committee for EM through its National Emergency Management Centre (NEMC), and 8 the Sectors, beside the Armed Forces and the Police.

- 2. Which sectors/ agencies do you have more coordination/collaboration with during disaster risk reduction phase and response phase?**

Response Phase:

1. Early warning
2. Public information & awareness
3. HAZMAT
4. Medical Response & Public Health
5. Relief & Shelter
6. Victim's Affairs
7. NEMC

Risk Reduction phase:

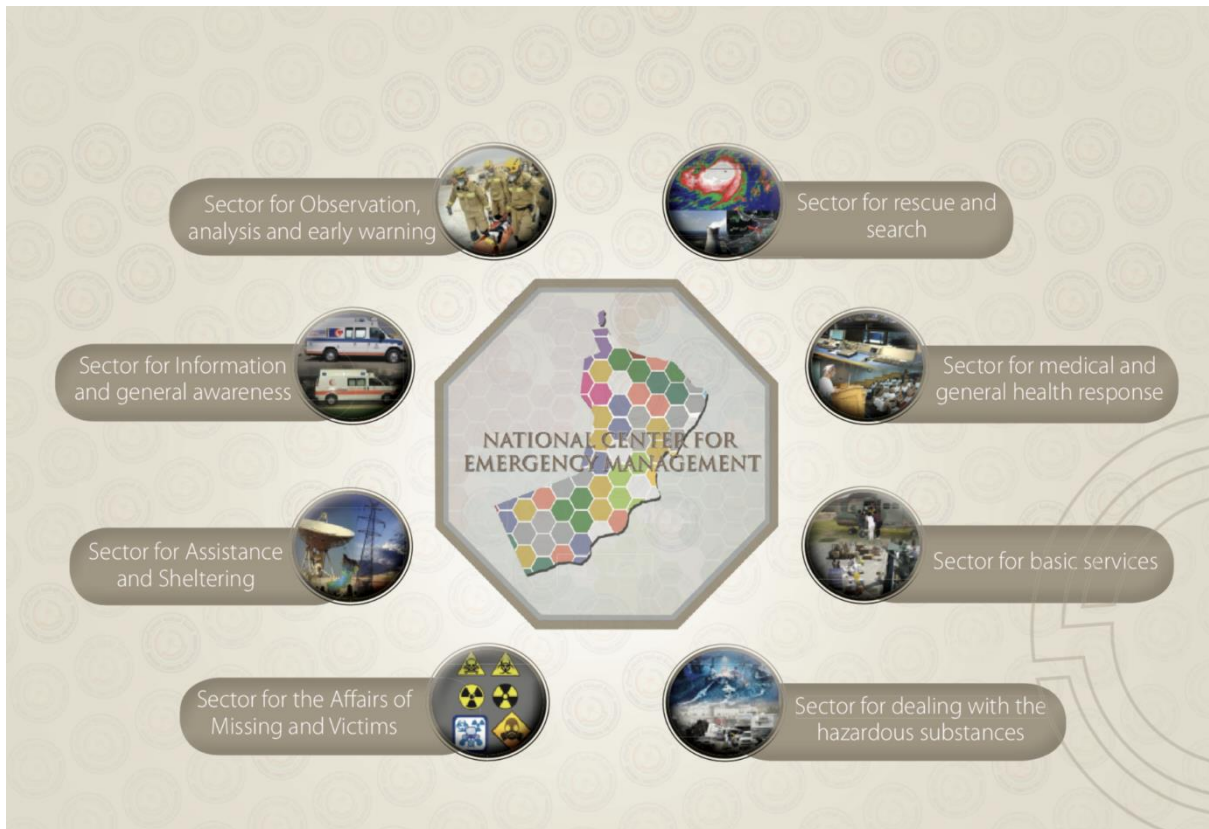
1. Supreme Council for Planning (SCP)
2. Cabinet Office
3. Ministry of Finance.
4. Ministry of Municipalities Water Resources
5. SQU Earth quick Monitoring Center
6. Ministry of Information
7. Ministry Of Education.
8. Early warning Sector

- 3. Do you see there to be differences in intersectoral coordination between risk reduction phase compared to the response phase? If yes, why?**

Let me start by saying that I think Oman has achieved an acceptable level of collaboration and coordination among various emergency response sectors/agencies when we compare the

existing system with the old institutional system (the pre 2010 system). However, there is a significant difference in the type of coordination structure, coordination roles and responsibilities, and how objectives are achieved in the Risk reduction phase and the response phase. Unlike response phase, coordination in the Risk reduction phase is the same as it used to be prior 2010. There is very limited coordination among various NCEM member organisations when it comes to risk reduction projects. First in the risk reduction phase, we deal with almost different organisations and different issues and challenge than those when we do response. So, Yes there is a noticeable variations between coordination in response and that of DR. As I have mentioned earlier, the type of issues and challenges (significant budgets and thus approval from the government), along with the believe that “if not is not broken, do not fix it”, and the long-term effect (unseen outcome) of DR measures/projects, makes coordination goes into the regular bureaucratic style, rather than the fast urgent response style of coordination.

Appendix 4: Sample of a Document Reviewed



(NECM 2018)

NATIONAL COMMITTEE FOR CIVIL DEFENSE

EMERGENCY:

Early phase before the year 1988, the dilemmas and emergencies in the Sultanate of Oman were managed by some government authorities like Royal Oman Police, Ministry of Interior, Ministry of Social Development and Ministry of Health in cooperation with some other government authorities according to their available facilities and based on the nature of dilemmas and emergencies.

The first real step of these authorities was the involvement for providing the human helps for the residents during the storm attacked across the Masirah Island and some regions of the Dhofar Governorate in June 1977, and the committee has been formed under the presidency of the Hon. Minister of Social Development and membership of some government concerned authorities and was functioning then on that frame.

Appendix 5: Abbreviations of the Oman Emergency Management System Member organisations.

	Code	Details
1.	CbankOm	Central Bank of Oman
2.	CIChambr	Chamber of Commerce & Industry
3.	CIS	Critical Infrastructure Sector
4.	CivDefAA	Civil Defence Authority
5.	CivilAA	Civil Aviation Authority
6.	CnsmrPA	Consumer Protection Authority
7.	CoMinst	Council of Ministers
8.	Comm.Reg.A	Communication Regulation Authority
9.	EnvA	Environment Authority
10.	ENVCOM	Waster Management Company
11.	EWS	Early Warning Sector
12.	Ferry	National Ferry Company
13.	HAZMAT	HAZMAT Sector
14.	IGOs	inter-Governmental Organisations
15.	Indus.Zon	Industrial & Free trade Zones
16.	MCom.Ind	Ministry of Commerce & Industry
17.	MCultTrsm	Ministry of Culture & Tourism
18.	MDef	Ministry of Defence
19.	MEdu	Ministry of Education
20.	MFA	Ministry of Foreign Affairs
21.	MFisAgr	Ministry of Fisheries & Agriculture
22.	MFin	Ministry of Finance
23.	MHEdu	Ministry of Higher Education
24.	MHlth	Ministry of Health
25.	MInfo	Ministry of Information
26.	MInterior	Ministry of Interior

27.	municipal	Municipalities
28.	MOSD	Ministry of Social Development
29.	MPWS	Media & Public Awareness Sector
30.	MRilgAff	Ministry of Religious Affairs
31.	MRPHS	Medical Response & Public Health Sector
32.	MTT	Ministry of Transport, Telecom, & Information Technology
33.	MYthSrpt	Ministry of Youth & Sports
34.	NEMC	National Emergency Management Center
35.	NGOs	Non-Governmental Organisations
36.	OilMinrl	Ministry of Oil & Minerals
37.	OmanAir	Oman Air
38.	Omcharity	Oman Charitable Organisation
39.	ONCSC	Oman National Committee for Science and Culture
40.	PPrsc	Public Prosecution
41.	PrivSec	Private Sector
42.	PServA	Public Services Authority
43.	R&SS	Relief & Shelter Sector
44.	ROP	Royal Oman Police
45.	S&RS	Search & Rescue Sector
46.	SCP	Supreme Council for Planning
47.	SQU	Sultan Qaboos University
48.	TELCCOM	Telecommunication Companies
49.	Univ&Colg	Universities & Colleges
50.	Utility Co	Power/Electricity Companies
51.	VAS	Victim Affairs Sector
52.	Voulnteer	Volunteers
53.	WatRsc	Water Resources Department
54.	WaterSEWG	Water & Sewage Company